The Tool Engineer

& WESSON—THE REVOLUTIONARY DECADE . . . P. 55

CATION OF THE AMERICAN SOCIETY OF TOOL ASTE ENGINEERS

AUGUST, 1951
VOLUME XXVII, NO. 2

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VOLUME XXVI
NUMBER 2
AUGUST, 1951

The Tool Engineer

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AMERICAN SOCIETY OF TOOL ENGINEERS

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OFFICE OF PUBLICATION: 330 E. Chicago St., Milwaukee, Wis.
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Thread Cost—2/10¢ Per Piece

LANDEX HEAD THREADS 300 PIECES PER HOUR AT LOW TOOL COST!!!

These operations illustrate a case history of the economy and efficiency of the LANDEX Head, designed for cutting precision threads at high production rates on automatic screw machines and other "live" spindle equipment.

In this instance, ½" American Standard Pipe Threads are being generated on sprinkler frames cast of red brass. The threads are cut into a relief 3/32" wide.

The wisdom of the tool engineer in selecting LANDEX Heads for performing these threading operations is borne out by information secured from the cost sheets. Production consistently averages 300 pieces per hour, floor-to-floor time, at a total threading cost of two-tenths of a cent per piece. Tool cost was held to a minimum with 5,000 pieces being threaded between chaser grinds.

This is just one example of many successful applications of the LANDEX Head to jobs requiring high-speed thread production at an economical cost. For additional information, write for Bulletin F-90.

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Multiple spindle automatics equipped with Hardinge Master Collets and Pads give solid collet performance—at low cost. Pads are interchangeable among different machines with same capacity. Available for all sizes of the following machines up to and including 3½" capacity:

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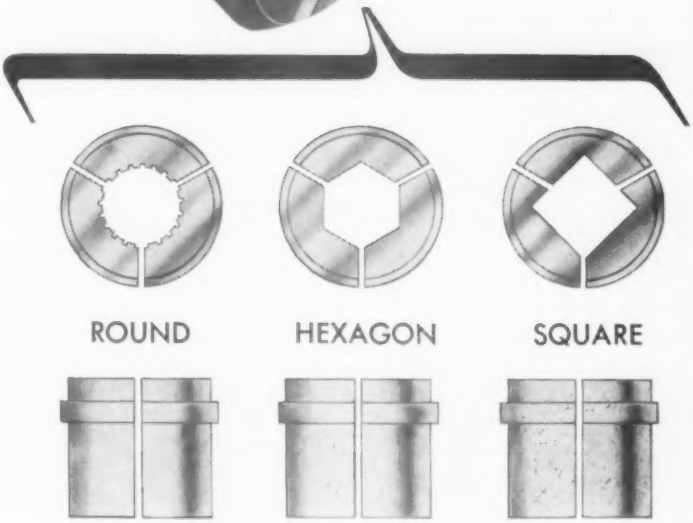

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HARDINGE
ELMIRA, N.Y.

accurate forming

on a Cincinnati solved this problem

Note the clean, straight lines of the moldings formed on the shelf by this Cincinnati Press Brake.

These outstanding sectional Bulman display shelves fit accurately.
Photo courtesy E. O. Bulman Mfg. Co., Inc., Grand Rapids 2, Michigan.

Accurate forming paid off in three ways for Bulman Company, manufacturers of steel display shelves.

Trouble had been experienced in maintaining regularity of product. Now the clean, straight line formed from end to end of the shelving permits a perfect match-up of sections, eliminating a costly trim piece.

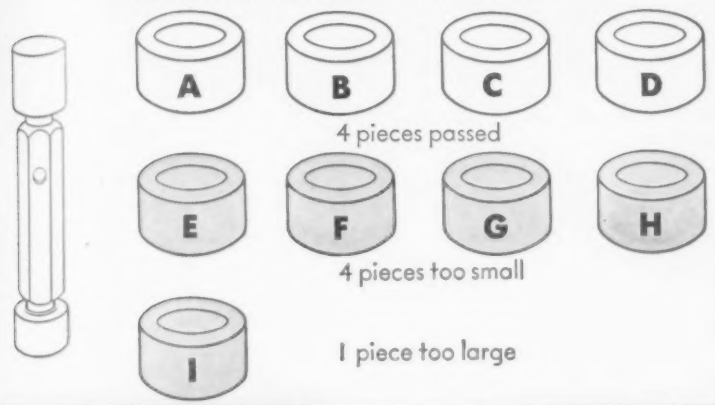
Better product, with no discards, and one piece completely eliminated, were the results when this Cincinnati Press Brake was installed . . . it was a profitable investment.

Write for Catalog B-2A—a Cincinnati Press Brake may improve your product and reduce your costs.

THE CINCINNATI SHAPER CO.
CINCINNATI 25, OHIO U.S.A.
SHAPERS · SHEARS · BRAKES

An ABC Demonstration of DuBo* Plug Gage Superiority

Inspection of 9 pieces using conventional plug gage
Bore Diam. 1.500"; Total Tolerance .001"



RESULTS of same inspection using DuBo Plug Gage

Of the 4 pieces passed by conventional plug gage above, only 3 are actually within specified limits when inspected with the more sensitive DuBo plug gage.

DuBo reveals piece D (passed above) is too large.

Of the 4 rejected as too small by conventional plug gage, E and F are actually within the limit when inspected with DuBo plug gage.

I, rejected by conventional gage as too large, is so verified when inspected with DuBo plug gage.

Of nine pieces inspected, DuBo reclaimed two false rejects and rejected one piece that had been passed by ordinary plug gage inspection. Apply even a fraction of this ratio to a day's production in your own plant and you'll realize the advantage of using DuBo plug gages.

*U.S. and Foreign Patents Granted

At left:
SINGLE END
DuBo Plug. Sizes
1.510" to 6.010"

At right:
DOUBLE END
DuBo Plug. Sizes
.240" to 1.510"

DuBo Plugs Wear 5 to 10 Times Longer than Conventional Plugs

The spherical gaging surface of the DuBo plug gage, specially relieved, has the advantage of easy entry, with contact only at the point of gaging. Lightness in weight, sensitivity and finger-tip control also mean speed and less wear.

Don't Let Profits "Fly Out the Window"

You'll actually save money by using this modern plug gage instead of the out-moded cylindrical plug. DuBo keeps down that high cost of parts needlessly rejected or incorrectly passed. It's all in the design. DuBo plugs simply check better because of the spherical principle on which they are based.

DuBo Saves Inspection Man-Hours

DuBo is only about one-fifth the weight of corresponding conventional plug gages. This factor, coupled with "go" and "not go" color identification, definite check, ease of entry and absence of jamming, reduces inspection time, saves money and increases profitable production! **Write or phone any questions you have on this vastly better checking device.**

STANDARD GAGE CO., Inc., Poughkeepsie, N.Y.

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TROUBLE-FREE OPERATION, with reduced chatter, under difficult conditions is an inbuilt feature of National "Shearing Action" Milling Cutters. In addition, National "Shearing Action" Milling Cutters give unusually long wear, with top production and performance.

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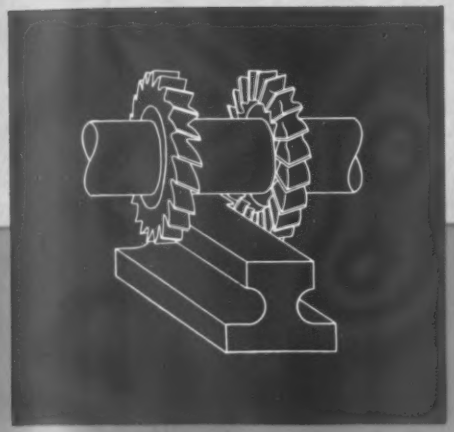

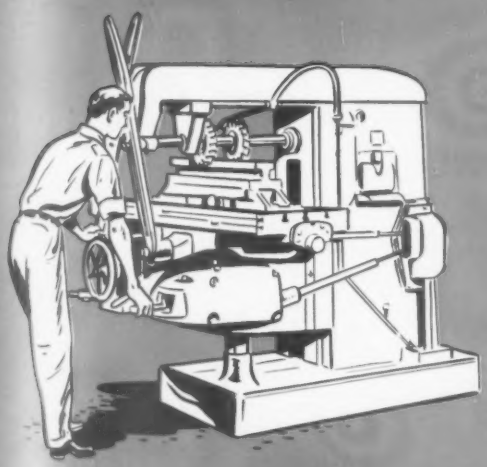

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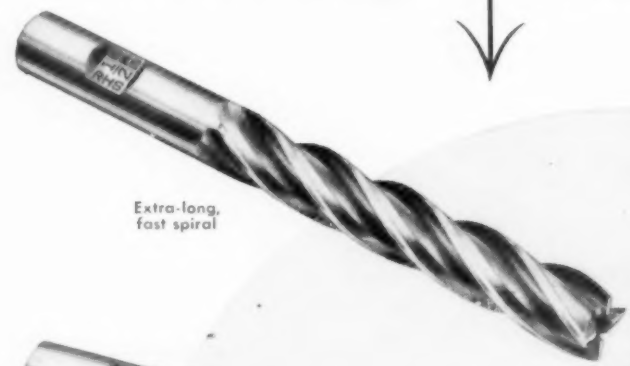
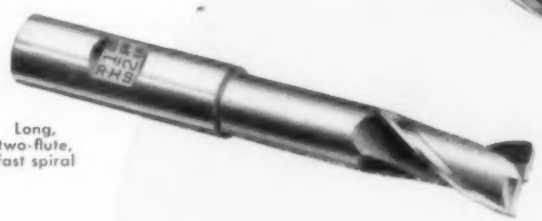
To assure maximum productivity from your milling machines, specify end mills and other cutters from the complete Brown & Sharpe line. Write for Catalog.
Brown & Sharpe Mfg. Co., Providence 1, R. I., U.S.A.

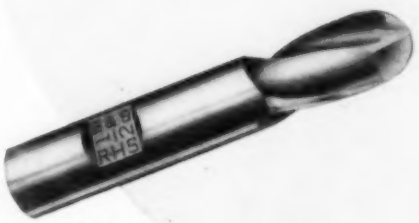


Extra-long, fast spiral



Long, two-flute, fast spiral

Fast spiral, double end



Ball end, two-flute, fast spiral

WE URGE BUYING THROUGH THE DISTRIBUTOR

Brown & Sharpe B·S

Be sure spindle and back plate run true.

Mount on adapter to facilitate changing wheels.

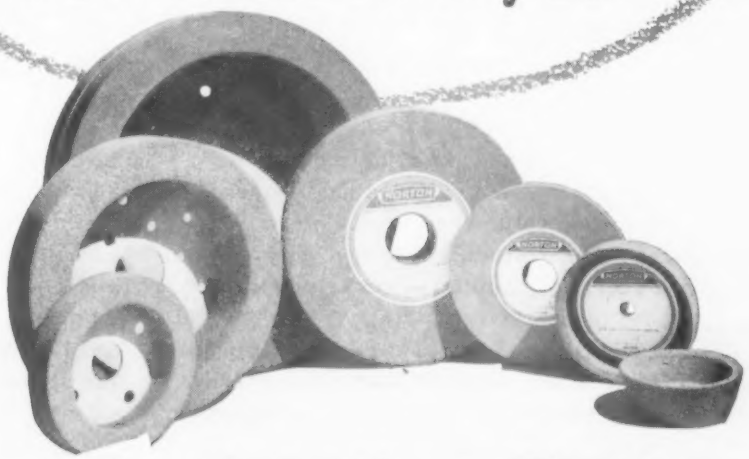
Maintain correct wheel speeds for bond types.

Grind wet whenever possible.

Dress wheels only when necessary.

Use Norton training films on carbide grinding and diamond wheel operation.

Tips on Diamond Wheel Operation THAT WILL Lengthen Wheel Life and Cut Carbide Grinding Costs



AND ...Investigate The New K-Bond Crystolon* Wheels

These faster, freer cutting silicon carbide wheels give you greatly increased uniformity of grinding action. This new vitrified bond is so accurately controllable that half-grade increments of hardness are possible — enabling you to "pin-point" specifications to your individual needs. In many cases Norton K-Bond CRYSTOLON wheels permit saving your more expensive diamond wheels for finishing, since they take care of numerous rough grinding jobs with entire satisfaction.

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is your contact point for a vast store of knowledge covering every detail of abrasives and grinding — available through Norton Abrasive Engineers in every industrial center, and through the Norton specialists in Worcester. See your Norton Distributor for the *right* wheels to use in your carbide grinding applications, and ask him for this free 140-page booklet on carbide grinding. Or write direct for FORM 167. NORTON COMPANY, Worcester 6, Mass. Distributors in all principal cities.

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NORTON ABRASIVES

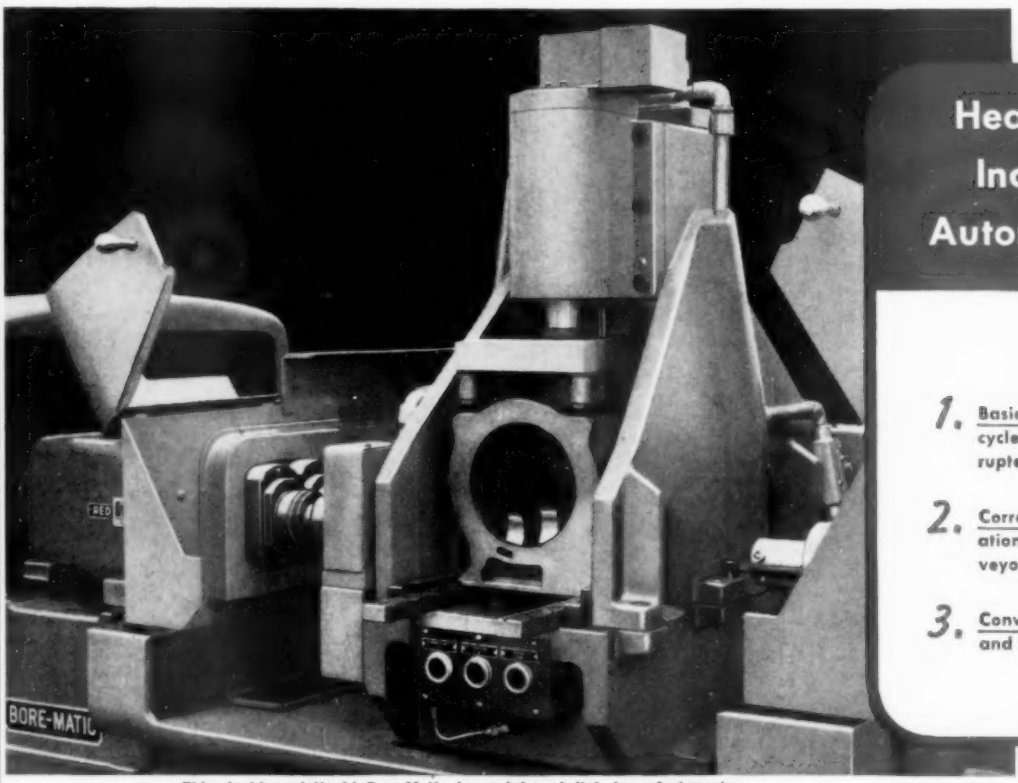
Making better products to make other products better

When production lines shift to defense, the PROVED DEPENDABILITY *of Heald machines helps to* KEEP 'EM ROLLING

There's no room for weak links in the chain of operations that makes up your production line — especially when you're tooling up for vital defense orders. That's where Heald's extra dependability and proved precision can help you off to a good start — and keep production rolling around the clock.

The new Heald Bore-Matics and grinding machines have won their service stripes in the most competitive fields of highly mechanized production — setting enviable records for speed, efficiency and dependability. This background of proved performance — plus Heald's unequalled engineering experience in all fields of precision finishing — can smooth the way for faster, easier conversion, and *sustained production* that will meet the most exacting requirements.

Remember — when it comes to precision finishing, it pays to come to Heald.



This double-end Heald Bore-Matic is an integral link in a fast-moving automotive conveyor line, borizing cross holes in transmission housings.

Heald Bore-Matic Setup Increases Efficiency of Automotive Conveyor Li

HERE'S WHY

1. Basic Dependability — sound design and rel cycle functions provide the maximum in uni rupted production.
2. Correct Working Height — combines ease of o ation and loading with required level for a veyor setup.
3. Convenient Operation — automatic operating c and fixture equipment controlled by push b

HEALD

THE HEALD MACHINE COMPANY

WORCESTER 6, MASSACHUSETTS

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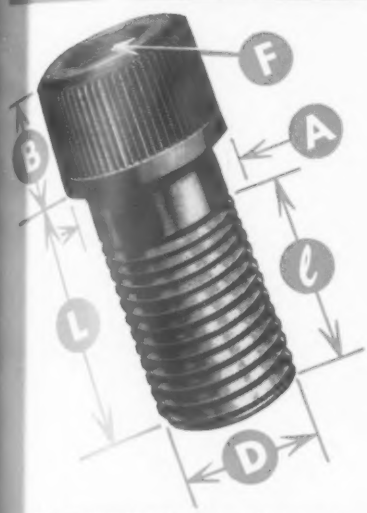
UNBRAKO®

SOCKET HEAD CAP SCREWS

B (Head height) = D (Screw Diameter)



Standard UNBRAKO thread lengths are computed from the following formulas: "**Thread length, 1.**—A screw thread is measured from the extreme point to the last usable thread and shall be as follows:

For American National coarse.

- $\ell = 2D + \frac{1}{2}$ in. (where this length of thread would be greater than half the screw length).
- $\ell = \frac{1}{2}L$ (where this length of thread would be greater than $2D + \frac{1}{2}$ in.).

For American National fine.

- $\ell = 1\frac{1}{2}D + \frac{1}{2}$ in. (where this length of thread would be greater than three-eighths the screw length).
- $\ell = \frac{3}{8}L$ (where this length of thread would be greater than $1\frac{1}{2}D + \frac{1}{2}$ in.).

Screws too short to allow application of these formulas shall be threaded as close to the head as practicable."

(Quoted from National Bureau of Standards Handbook H-28)

★ **One of a series listing *Standard* UNBRAKO Socket Screw Products sold by your local UNBRAKO Distributor. If you want reprints of this and other advertisements in the series, ask for them on your business letterhead.**

SPS

STANDARD PRESSED STEEL CO.

JENKINTOWN 37, PENNSYLVANIA

Diameter	Threads per inch NC	Threads per inch NF	Length	Thread Length NC	Thread Length NF	Price per 100	Quantity per box
#4 (.112")	40		1/4	1/4		4.65	100
	40		3/8	3/8		4.70	100
	40		1/2	1/2		4.90	100
A .183"	40		5/8	5/8		5.10	100
F 3/16"	40		3/4	3/4		5.35	100
#5 (.125")	40		1/4	1/4		4.70	100
	40		3/8	3/8		4.75	100
	40		1/2	1/2		4.95	100
A .205"	40		5/8	5/8		5.15	100
F 7/32"	40		3/4	3/4		5.35	100
#6 (.138")	32	40	1/4	1/4	1/4	4.75	100
	32	40	3/8	3/8	3/8	4.80	100
	32	40	1/2	1/2	1/2	5.00	100
	32	40	5/8	5/8	5/8	5.20	100
A .226"	32	40	3/4	3/4	3/4	5.45	100
F 7/32"	32		7/8	7/8		5.75	100
	32		1	1		6.15	100
#8 (.164")	32		1/4	1/4		4.85	100
	32	36	3/8	3/8	3/8	4.90	100
	32	36	1/2	1/2	1/2	5.10	100
	32		5/8	5/8		5.35	100
A .270"	32	36	3/4	3/4	3/4	5.60	100
	32		7/8	7/8		5.85	100
F 1/4"	32		1	1		6.35	100
	32		1 1/4	1 3/16		7.10	100
	32		1 1/2	1 3/16		7.85	100
#10 (.190")	24	32	3/8	3/8	3/8	5.05	100
	24	32	1/2	1/2	1/2	5.30	100
	24	32	5/8	5/8	5/8	5.55	100
	24	32	3/4	3/4	3/4	5.80	100
A 5/16"	24	32	7/8	7/8	7/8	6.05	100
	24	32	1	1	1 3/16	6.55	100
F 5/32"	24	32	1 1/4	7/8	1 3/16	7.30	100
	24	32	1 1/2	7/8	1 3/16	8.05	100
	24	32	1 3/4	7/8	1 3/16	8.80	100
	24	32	2	1	1 3/16	9.55	100
1/4 (.250")	20	28	3/8	3/8	3/8	5.25	100
	20	28	1/2	1/2	1/2	5.50	100
	20	28	5/8	5/8	5/8	5.75	100
	20	28	3/4	3/4	3/4	6.00	100
A 3/8"	20	28	7/8	7/8	7/8	6.25	100
	20	28	1	1	1	6.75	100
F 3/16"	20	28	1 1/4	1	7/8	7.50	100
	20	28	1 1/2	1	7/8	8.25	100
	20	28	1 3/4	1	7/8	9.00	100
	20	28	2	1	7/8	9.75	100
	20	28	2 1/4	1 1/8	7/8	10.50	100
	20		2 1/2	1 1/4		11.25	100
	20		2 3/4	1 3/8		12.00	100
	20		3	1 1/2		13.50	100
5/16 (.3125")	18		3/8	3/8		6.25	100
	18	24	1/2	1/2	1/2	6.50	100
	18	24	5/8	5/8	5/8	6.75	100
	18	24	3/4	3/4	3/4	7.00	100
A 7/16"	18	24	7/8	7/8	7/8	7.25	100
	18	24	1	1	1	7.75	100
F 7/32"	18	24	1 1/4	1 1/4	1	8.50	100
	18	24	1 1/2	1 1/8	1	9.25	100
	18	24	1 3/4	1 1/8	1	10.00	100
	18	24	2	1 1/8	1	10.75	100
	18	24	2 1/4	1 1/8	1	11.50	100
	18	24	2 1/2	1 1/4	1	12.50	100
	18		2 3/4	1 3/8		13.50	100
	18		3	1 1/2		14.50	100
	18		3 1/4			16.00	100
	18		3 1/2			17.50	100
3/8 (.375")	16	24	1/2	1/2	1/2	7.40	100
	16	24	5/8	5/8	5/8	7.70	100
	16	24	3/4	3/4	3/4	8.00	100
	16	24	7/8	7/8	7/8	8.50	100
A 9/16"	16	24	1	1	1	9.00	100
	16	24	1 1/4	1 1/4		10.00	100
F 5/16"	16	24	1 1/2	1 1/2	1 1/16	11.00	100
	16	24	1 3/4	1 1/4	1 1/16	12.00	100
	16	24	2	1 1/4	1 1/16	13.00	100
	16	24	2 1/4	1 1/4	1 1/16	14.00	100
	16	24	2 1/2	1 1/4	1 1/16	15.00	50
	16		2 3/4	1 3/8		16.00	50
	16	24	3	1 1/2	1 1/8	17.50	50
	16		3 1/4	1 5/8		19.00	50
	16		3 1/2	1 3/4		20.50	50
	16		4	2		24.00	50
	16		4 1/2	2 1/4		28.00	50
	16		5	2 1/2		32.00	50
7/16 (.4375")	14		1/2	1/2		8.90	100
	14		5/8	5/8		9.20	100
	14		3/4	3/4		9.50	100
	14		7/8	7/8		10.00	100
A 5/8"	14	20	1	1	1	10.50	100
	14	20	1 1/4	1 1/4	1 1/4	11.50	100
F 3/16"	14	20	1 1/2	1 1/2	1 3/16	12.50	100
	14		1 3/4	1 3/8		13.50	100
	14	20	2	1 3/8	1 3/16	14.50	50
	14		2 1/4	1 3/8		15.50	50
	14		2 1/2	1 3/8		17.00	50

Diameter	Threads per inch NC	Threads per inch NF	Length	Thread Length NC	Thread Length NF	Price per 100	Quantity per box
7/16 (.4375")	14		2 3/4	1 3/8		18.50	50
	14		3	1 1/2		20.00	50
	14		3 1/4	1 5/8		21.50	50
A 5/8"	14		3 1/2	1 3/4		23.00	50
F 3/16"	14		4	2		27.00	50
1/2 (.500")	13		1/2	1/2		10.20	100
	13		5/8	5/8		10.60	100
	13		3/4	3/4		11.00	100
	13		7/8	7/8		11.75	100
A 3/4"	13		1	1	1	12.25	100
	13		1 1/4	1 1/4	1 1/4	13.50	100
F 3/8"	13		1 1/2	1 1/2	1 1/2	14.75	100
	13		1 3/4	1 1/4	1 1/4	16.00	50
	13		2	1 1/2	1 1/4	17.25	50
	13		2 1/4	1 1/2	1 1/4	18.50	50
	13		2 1/2	1 1/2	1 1/4	20.00	50
	13		2 3/4	1 1/2		21.50	50
	13		3	1 1/2	1 1/4	23.00	50
	13		3 1/4	1 5/8		24.50	50
	13		3 1/2	1 3/4		26.00	50
	13		4	2		29.00	50
	13		4 1/2	2 1/4		32.00	50
	13		5	2 1/2		35.00	50
	13		5 1/2	2 3/4		38.00	50
	13		6	3		41.00	50
	13		6 1/2	3 1/4		44.00	50
	13		7	3 1/2		50.00	50
	13		8	4		62.00	50
5/8 (.625")	11		1	1	1	18.00	50
	11		1 1/4	1 1/4	1 1/4	19.75	50
	11		1 1/2	1 1/2	1 1/2	21.50	50
	11		1 3/4	1 3/4	1 3/4	23.25	50
A 7/8"	11		2	2	1 7/8	25.00	50
	11		2 1/4	1 3/4		27.00	25
F 1/2"	11		2 1/2	1 3/4	1 7/8	29.00	25
	11		2 3/4	1 3/4		31.00	25
	11		3	1 3/4		33.00	25
	11		3 1/4	1 3/4		35.00	25
	11		3 1/2	1 3/4		37.00	25
	11		4	2		41.00	25
	11		4 1/2	2 1/4		45.00	25
	11		5	2 1/2		49.00	25
	11		5 1/2	2 3/4		53.00	25
	11		6	3		57.00	25
	11		6 1/2	3 1/4		62.00	25
	11		7	3 1/2		70.00	25
	11		8	4		85.00	25
3/4 (.750")	10		1 1/4	1 1/4		24.00	50
	10		1 1/2	1 1/2		26.00	25
	10		1 3/4	1 3/4		28.00	25
	10		2	2		30.00	25
A 1"	10		2 1/4	2 1/4		33.00	25
	10		2 1/2	2		36.00	25
F 5/16"	10		2 3/4	2		39.00	25
	10		3	2		42.00	25
	10		3 1/4	2		45.00	25
	10		3 1/2	2		48.00	25
	10		4	2		53.00	25
	10		4 1/2	2 1/4		58.00	25
	10		5	2 1/2		63.00	25
	10		5 1/2	2 3/4		68.00	25
	10		6	3		73.00	25
	10		6 1/2	3 1/4		79.00	25
	10		7	3 1/2		86.00	25
	10		8	4		102.00	25
7/8 (.875")	9		2	2		47.00	25
	9		2 1/4	2 1/4		50.00	25
	9		2 1/2	2 1/2		53.00	25
	9		2 3/4	2 1/4		56.00	25
A 1 1/16"	9		3	2 1/4		60.00	25
	9		3 1/4	2 1/4		64.00	25
F 5/16"	9		3 1/2	2 1/4		68.00	25
	9		4	2 1/4		74.00	25
	9		4 1/2	2 1/4		81.00	25
	9		5	2 1/2		88.00	25
	9		5 1/2	2 3/4		95.00	25
	9		6	3		102.00	25
	9		6 1/2	3 1/4		111.00	25
	9		7	3 1/2		120.00	25
	9		8	4		138.00	25
1 (1.000")	8		2	2		53.00	25
	8		2 1/4	2 1/4		56.00	25
	8		2 1/2	2 1/2		60.00	25
	8		2 3/4	2 3/4		65.00	25
A 1 1/16"	8		3	2 1/2		70.00	25
	8		3 1/4	2 1/2		75.00	25
F 3/8"	8		3 1/2	2 1/2		80.00	25
	8		4	2 1/2		88.00	25
	8		4 1/2	2 1/2		96.00	25
	8		5	2 1/2		105.00	25
	8		5 1/2	2 3/4		114.00	25
	8		6	3		123.00	25
	8		6 1/2	3 1/4		133.00	25
	8		7	3 1/2		143.00	25
	8		8	4		167.00	25

Prices subject to change without notice.

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Why order "specials"? UNBRAKO *standards* may do the job!

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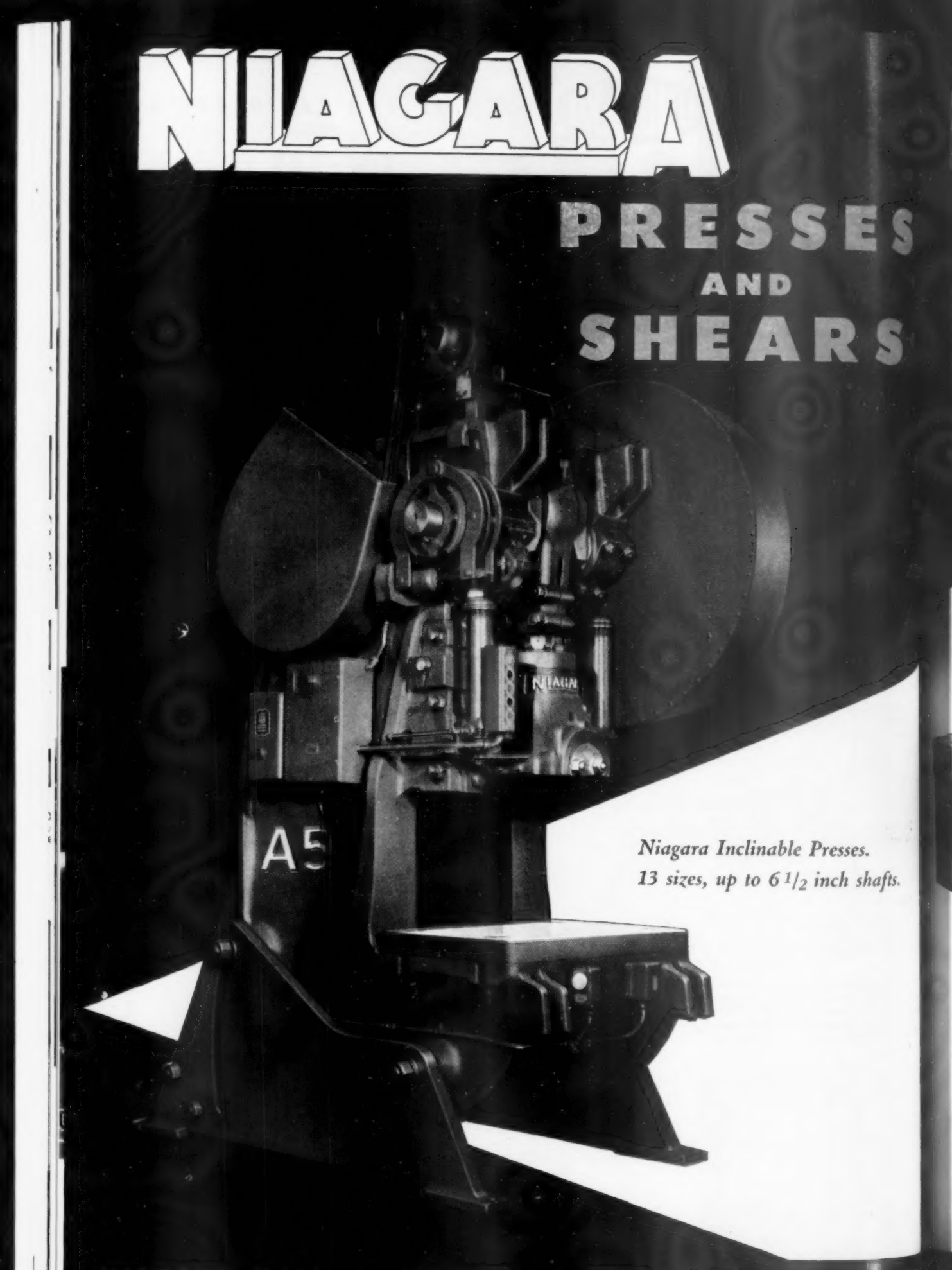

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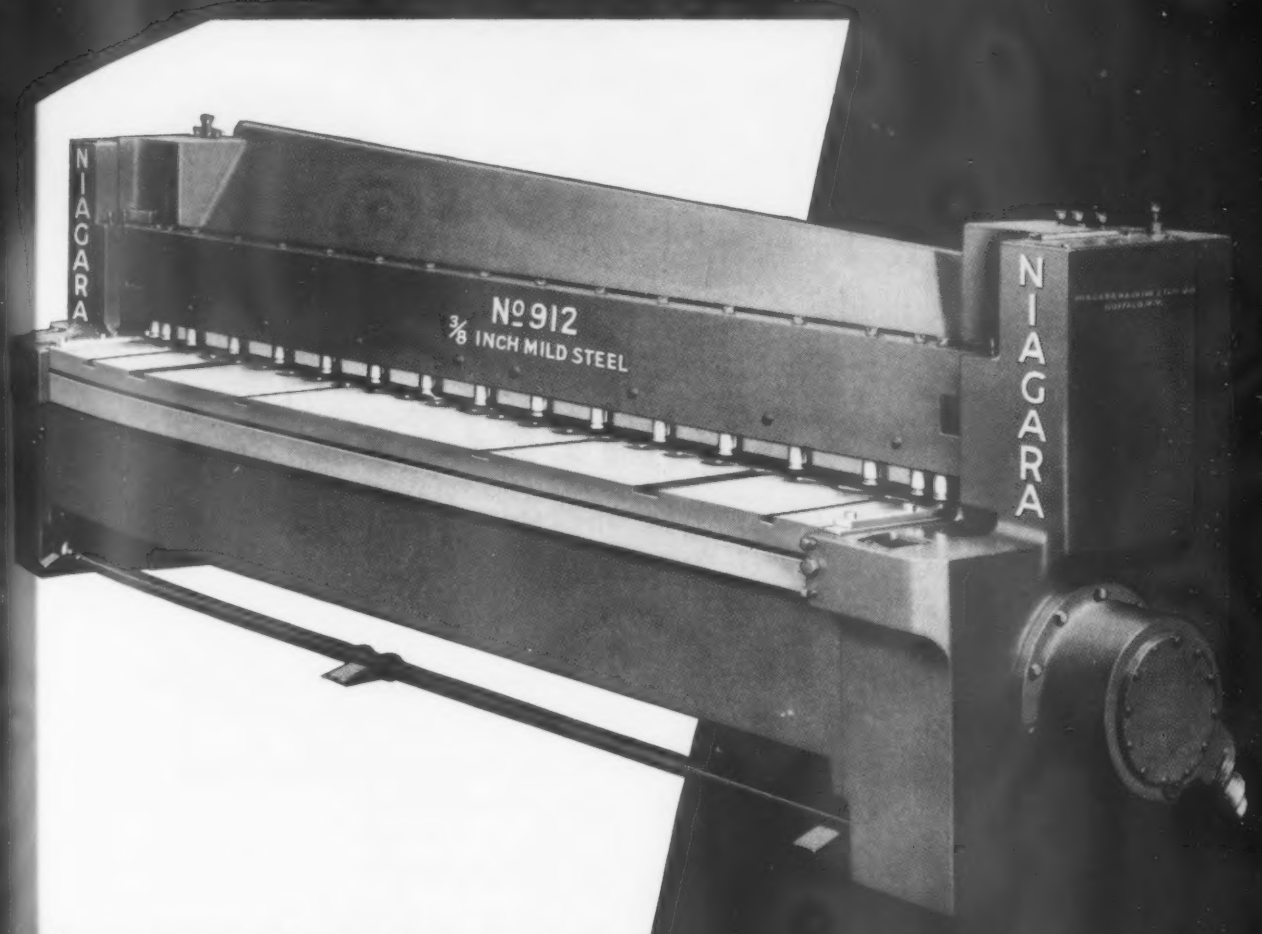

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Niagara Power Squaring Shears. Capacity from shim stock up to 1 inch thick steel. Lengths 3 feet to 20 feet.

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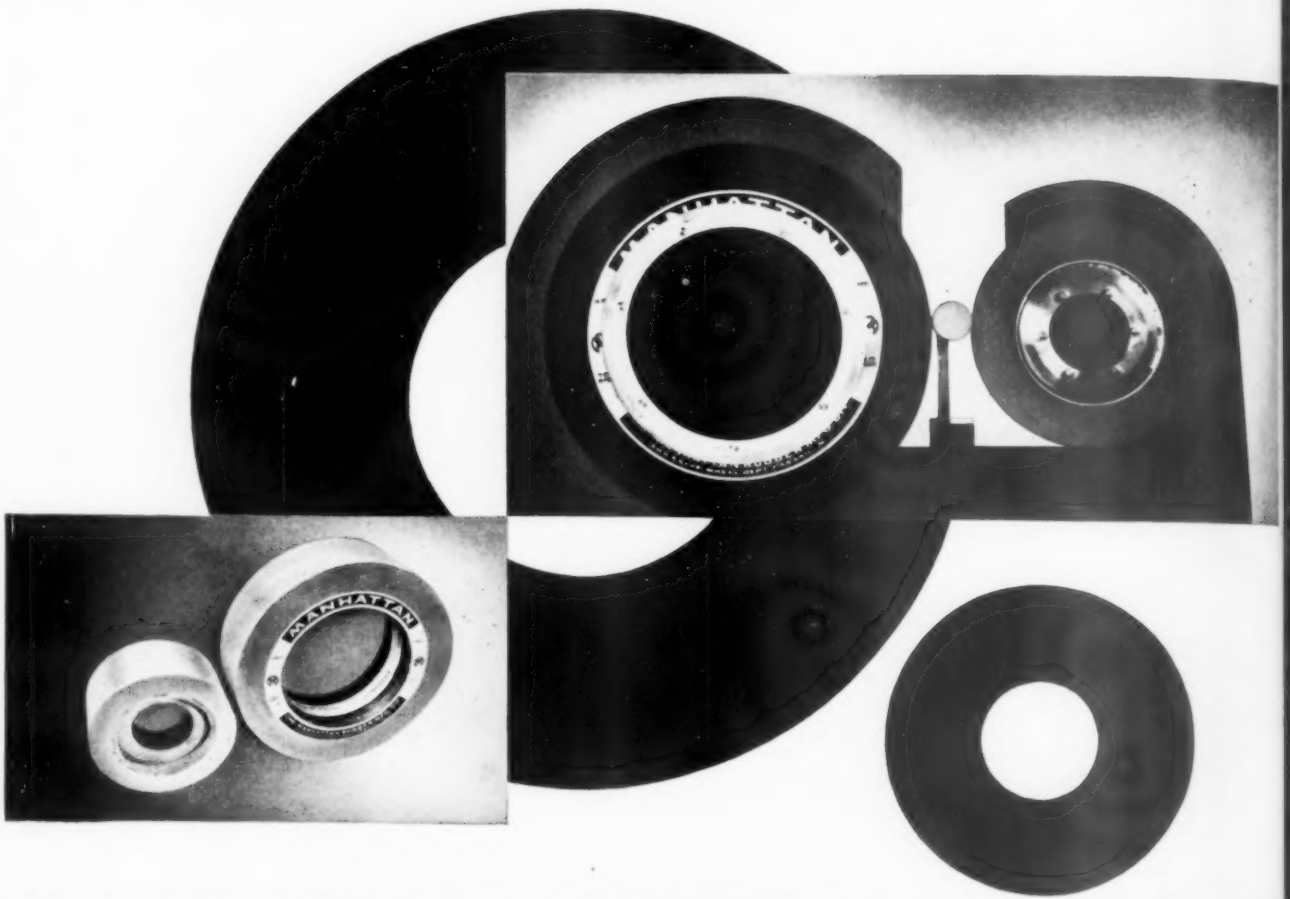

MANHATTAN CENTERLESS WHEELS

Using the same wheels for two jobs—roughing and finishing—saves two ways . . . Saves on wheel inventory . . . Saves wheel changing and machine setting time. Both savings lower your production costs with no reduction of quality.

Manhattan Centerless Wheels are custom-tailored for your work. This means higher output per wheel . . . and per man-hour.

Regulating wheels are supplied plain or core-mounted. Manhattan core mountings also effect substantial savings.

WRITE TO ABRASIVE WHEEL DEPARTMENT

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RAYBESTOS-MANHATTAN, INC.
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Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose • Fan Belts • Brake Linings • Brake Blocks • Clutch Facings • Packings • Asbestos Textiles • Powdered Metal Products • Abrasive & Diamond Wheels • Bowling Balls

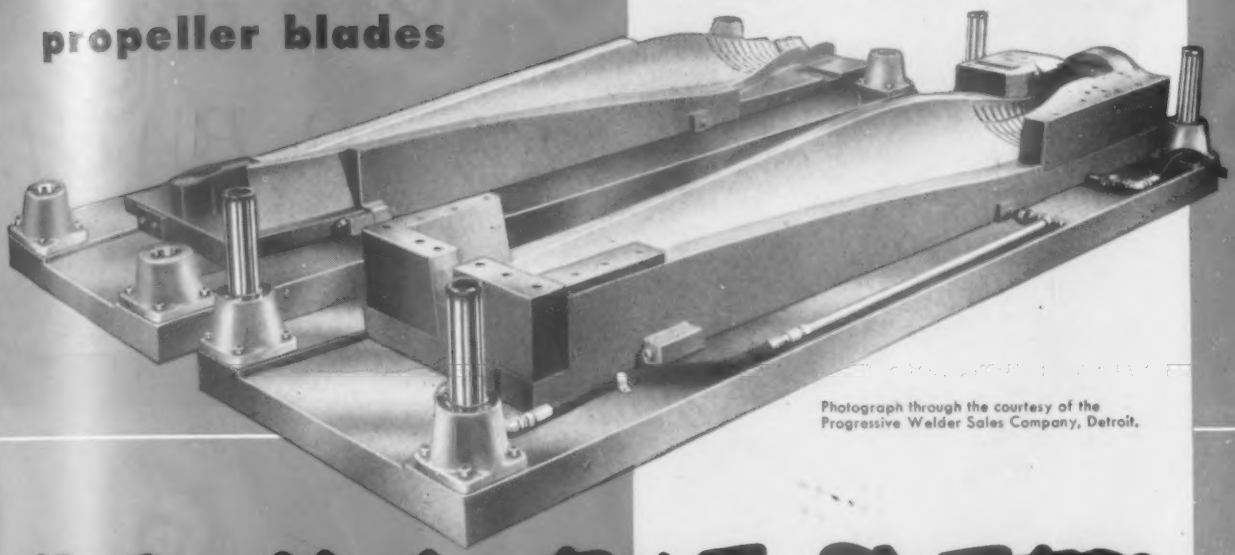
HOT FORMING

aircraft propeller blades

This unique new process takes a previously hot-worked billet and hot forms it into a one-piece hollow steel aircraft propeller. Now, in three steps requiring only a few minutes, a superior propeller is produced that formerly required hours of work.

The development gave rise to the problem of building a special 15 ton die that would provide a quenching action from 1450 degrees in a five minute press cycle.

For a die like this, the diemakers called for . . .



Photograph through the courtesy of the Progressive Welder Sales Company, Detroit.

DANLY DIE SETS

Reliable Danly precision plus unmatched facilities for the production of standard or special die sets like the one shown here make Danly Die Sets the first choice of diemakers everywhere. A nation-wide system of branch assembly plants* assures prompt, time saving service.

DANLY MACHINE SPECIALTIES, INC.
2100 South Laramie Avenue, Chicago 50, Illinois

*CALL ON YOUR NEAREST DANLY BRANCH

for fast, local delivery!

*CHICAGO 50, 2100 South Laramie Avenue
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PRECISION DIE SETS • STANDARD AND SPECIAL

MORE THAN 25 YEARS OF DEPENDABLE SERVICE TO THE STAMPING INDUSTRY

Take this Straight
from the
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MORSE
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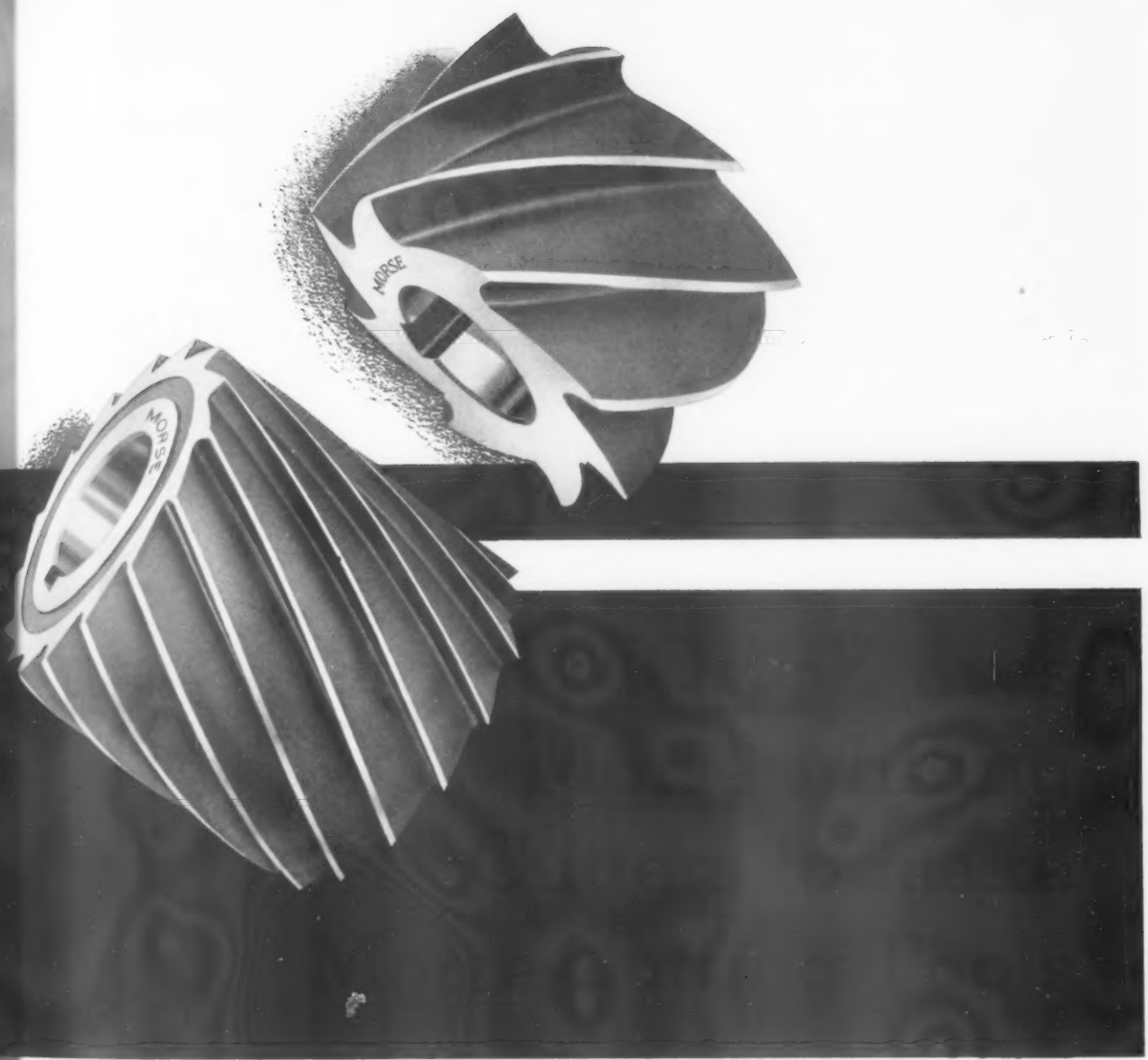

Yes, it's good horse-sense to buy Morse! For every day in the Morse plant, Morse Milling Cutters turn out thousands of cutting tools, made of the toughest tool steels. And this means that *you* . . . when *you* buy Morse Cutters . . . can know for sure that you're buying *Top Quality* that lasts longer . . . cuts smoother . . . *and delivers more pieces per grind.*

So just keep in mind that if you want Morse Quality and productivity, *you've got* to buy Morse Milling Cutters. And your Morse-Franchised Distributor is stocked to serve you *now* with the right cutters for your job . . . whether they be Angle, Form, Woodruff Keyseat or Saws for slitting and slotting . . . regular or Electrolized. Call your Morse-Franchised Distributor for *the cutters that cut deepest into milling costs.*

Morse Twist Drill & Machine Company
NEW BEDFORD, MASS.
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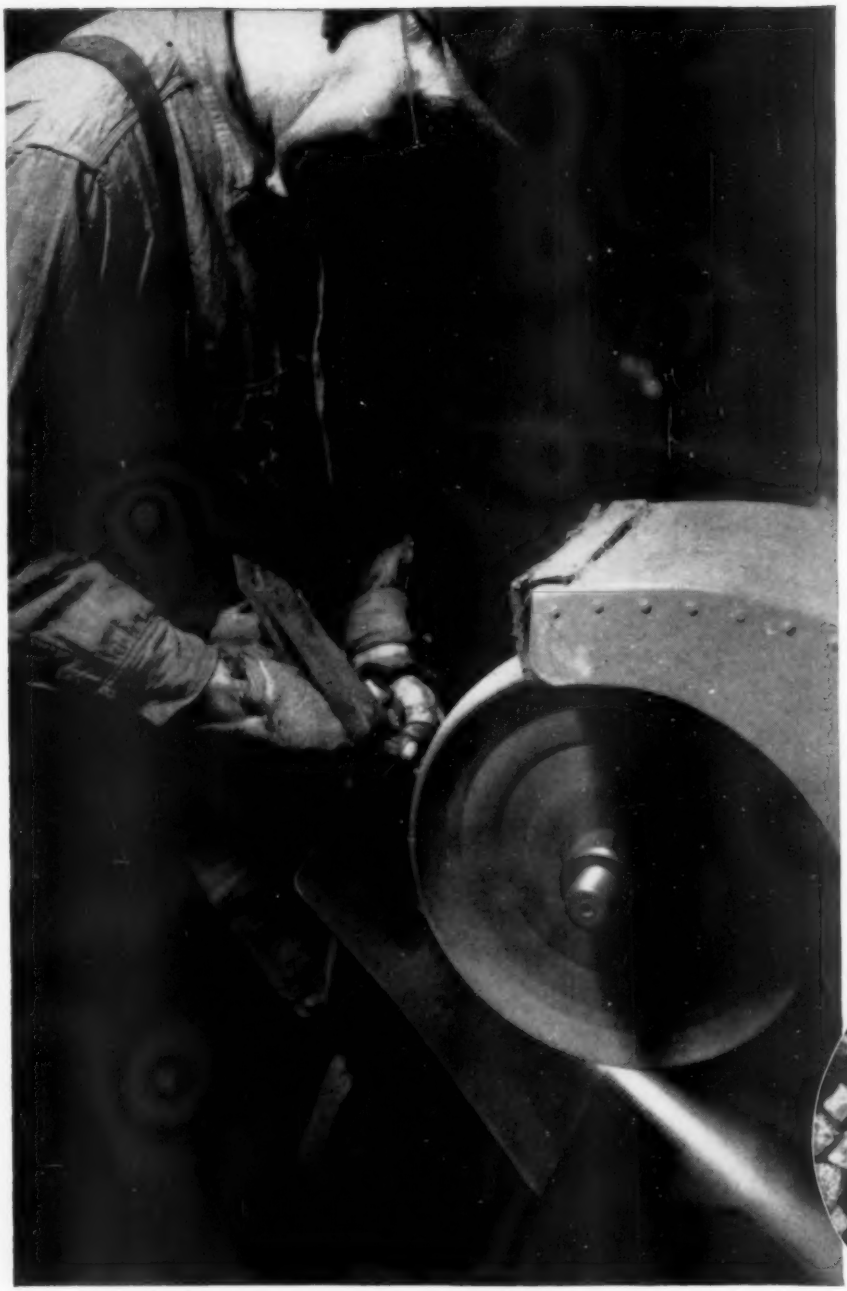
Warehouses in New York, Chicago, Detroit, Houston, San Francisco

MORSE
Cutting Tools

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-17



ALUNDUM ABRASIVE LASTS LONGER.. POLISHES BETTER...

Because Every Grain Works!

One of the biggest advantages of Norton ALUNDUM Polishing Abrasive is its complete uniformity of grain-size and shape. This means you get no oversize grains to mar the finish — *and no undersize grains to loaf on the job.* That's why, with every grain a working grain, ALUNDUM Abrasive lasts longer and performs better.

In addition, ALUNDUM Abrasive is uniform in chemical composition and crystal structure — extremely hard and tough for fast, clean cut — and has high capillarity that assures firmer adhesion of grain to wheel when glue is used as the adhesive. It is available in sizes and with surface treatments for best results on every polishing job.

Write for Norton Booklet No. 1340, "Setting-Up Polishing Wheels and Belts," containing many helpful polishing tips.

NORTON COMPANY
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Distributors in All Principal Cities

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ABRASIVES
Making better products to make other products better

Here's the quickest way!

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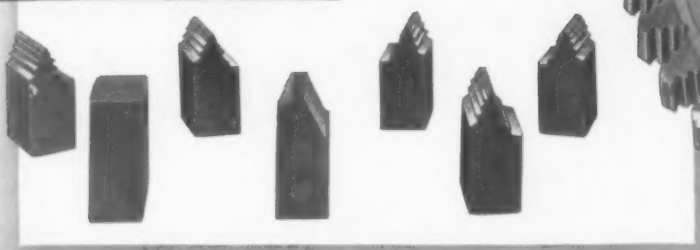
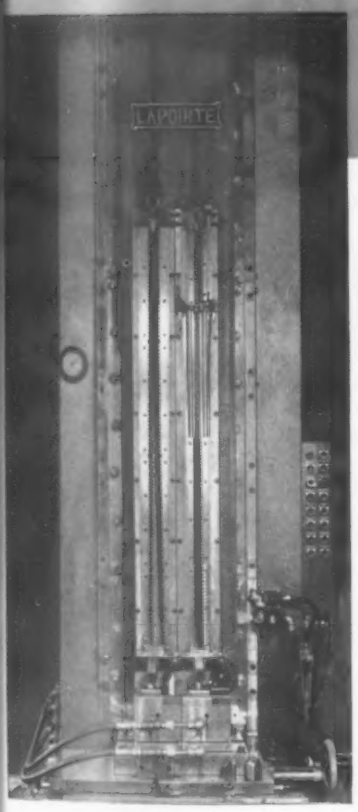
LAPOINTE





Single Ram Vertical Broaching Machine
WITH LAPOINTE TOOLS AND FIXTURES

Turbo-supercharger wheel and mating blades for
JET LOCOMOTIVE ENGINES
Both broached from the solid

This 15 ton, 90" stroke SRV LAPOINTE BROACHING MACHINE handles both jobs through interchangeable fixtures.

It broaches 32 pine tree slots in the wheel (a conventional forging) in 65 minutes, and 60 mating blade forms (from bar stock) in an hour! The fixture for the wheel has hydraulic clamping and is provided with completely automatic indexing. The fixture for the blades permits broaching two mating forms at the same stroke of the machine — one rough broached and one finished.

Another instance of LAPOINTE taking the responsibility for the COMPLETE Job: MACHINES, TOOLS, and FIXTURES!

THE Lapointe MACHINE TOOL COMPANY

Send for Bulletin SRV-5

HUDSON, MASSACHUSETTS • U. S. A.

Branch Factory: Watford, Herts., England

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHES AND BROACHING MACHINES

For the man who buys coolants on performance not promises, we have an interesting proposition.

We will: furnish, free of charge, all the Lusol necessary to conduct complete tests on machines in your shop. For more information, write for our 20-page book, "LUSOL—the all-chemical Metalworking Solution". F. E. Anderson Oil Company, 213C Brownstone Ave., Portland, Conn.

Lusol

ALL-CHEMICAL METALWORKING SOLUTION

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THE TOOL ENGINEER
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The Tool Engineer

a Letter from the Editor...

Last month in this space we announced the foundation of *The Tool Engineer* clearinghouse—a service by *The Tool Engineer* for tool engineers and industry.

Many readers have written for further information on the clearinghouse, and how its services might be applied to help them. Next month we'll have a special report on the subject; meanwhile a few points can be clarified here.

Reason for the clearinghouse, as we pointed out last month, is the unsettled nature of industry today. Within our broad membership we have plants working at full capacity on normal production. Other plants are to a greater or lesser extent switching to defense production —some attempting to maintain normal output on regular products, others aiming at a high ratio of defense production.

Under conditions such as these, production among individual plants is unbalanced. Many industries with which we are familiar are far behind in filling orders. Others, because of materials problems or other circumstances have or expect to have open capacity.

Therefore our service, rendered gratis as we said last month, aims at: (1) obtaining needed additional capacity for the manufacturer with a backlog; and (2) referring these inquiries to plants who have open capacity on the particular requirement.

Such requirements can, of course, embrace a wide field: machining or metal-forming operations; assemblies; engineering consultation; processing, layout or drafting aid; equipment or materials in tight supply—in short, any production requirement for which we can find a source.

This is our service; we invite you to make use of it.

Gilbert P. Munn

...how good can a valve be?

...THIS ONE HAS OPERATED 10,000,000 TIMES WITHOUT APPRECIABLE WEAR!

Hanna unitite Valves

YOU want a valve you can *depend* upon to operate faithfully d after day, month after month, year after year—without repacki . . . without adjustment . . . with nothing more than lubricati

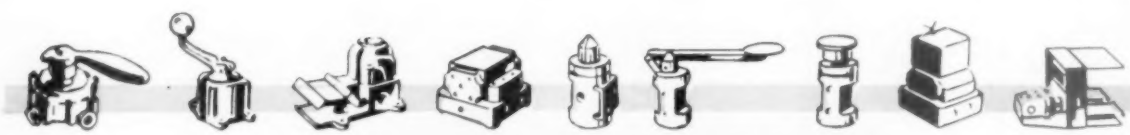
A running test under normal operating conditions shows th a Hanna Unitite Valve is still "going strong" after *10 milli cycles of operation*, and should be good for *another 10 milli* Based on eight cycles per minute for an eight-hour day, th would represent 20 years of care-free service!

This is not surprising, for Hanna Unitite Valves are made superior quality materials and parts. They are packless and pe manently tight, protected from dust and abrasive matter by Neoprene cap, and operate with a patented disc movement.

Unitites are designed for 3-way or 4-way operation, for air, or water, up to 250 psi. in three mounting styles. The Hann Valve Catalog gives full details.

Send for Catalog

New Valve Catalog 254 gives features and specifications on the complete line of Hanna Valves.



50th Anniversary 1901-1951

Hanna Engineering Works

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES . . . RIVETERS

1768 Elston Avenue, Chicago 22, Illinois

The Tool Engineer

Editorial

Serving Industry Through Education

FROM TIME TO TIME we have talked about some of the valuable services rendered by ASTE to its members and industry. High on the list of these activities is the combined Industrial Exposition and Annual Meeting, scheduled again just seven months from now.

The Exposition and Annual Meeting are important because they *serve*. The Exposition is more than just another trade show; industry has learned that it performs an outstanding function in spreading the gospel of cheaper and better production through advanced tooling, more efficient machines and better methods. Most reliable testimony to this is shown by the 18,843 visitors and 329 exhibitors who took part in ASTE's last Exposition in 1950.

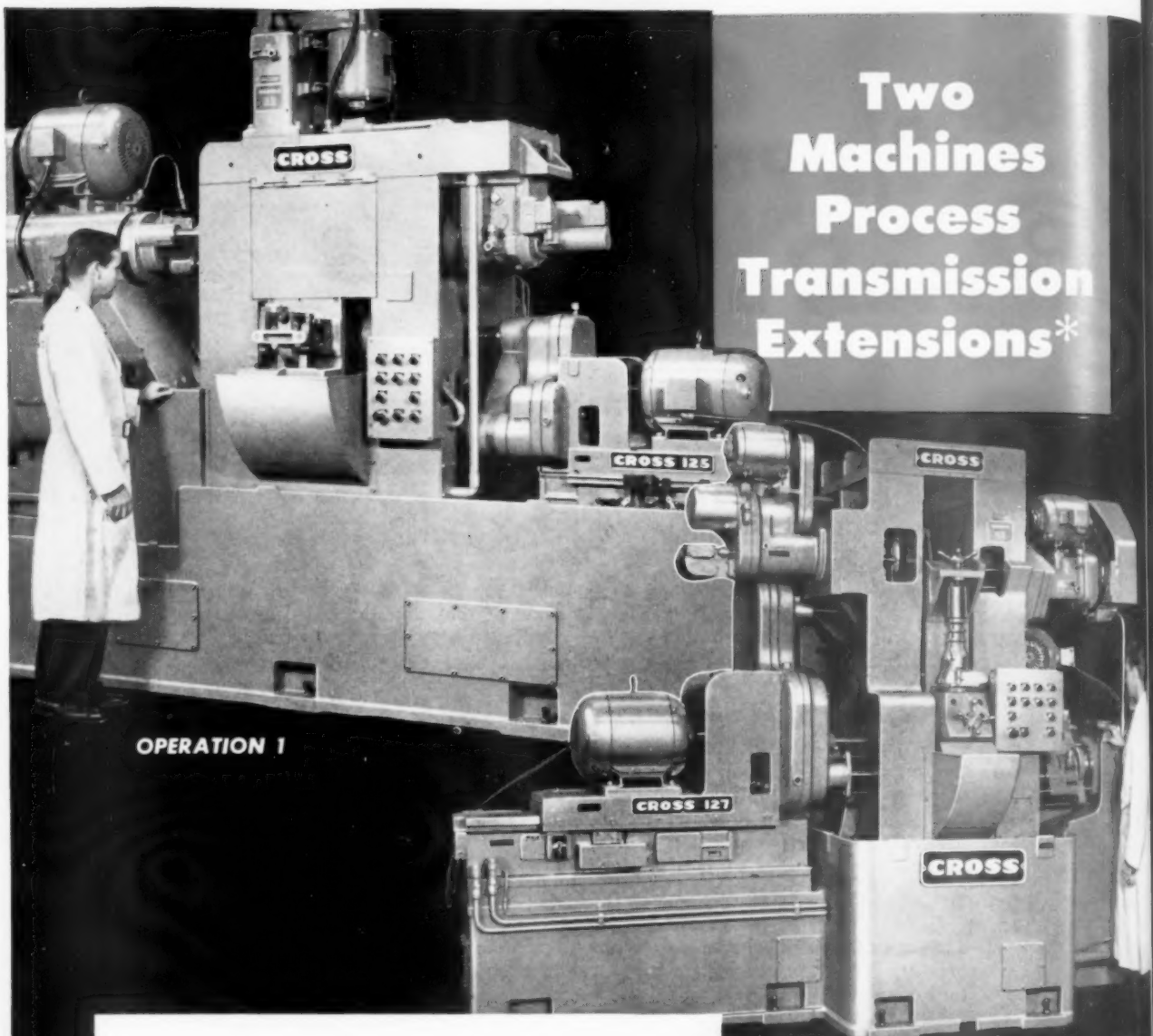
ASTE, in sponsoring 1952's Exposition and Annual Meeting will, as it has in the past, serve the profession and industry through three main channels:

1. Through the heavy schedule of technical sessions forming a part of the Annual Meeting, your Society brings the latest in processes and techniques to you as tool engineers.
2. Tool engineers and industry management from all over the world have an opportunity for first-hand inspection of the newest in materials and machines.
3. The many manufacturers serving industry with tools, materials and equipment have their best opportunity to demonstrate to tool engineers how industry's production problems can be helped.

Within a short time local and national committees working on the Exposition and Annual Meeting will announce full plans for technical sessions, special educational features, exhibits, plant tours and other program activities. With today's conditions, our '52 Exposition and Annual Meeting *must* be the best we have ever dedicated to industry.

J. Demuth

Two Machines Process Transmission Extensions*



OPERATION 1

OPERATION 2

- ★ Operation 1: bore both ends; face large end; ream flange holes in large end; oil groove small end; chamfer and tap two holes in mounting flange.
- ★ Operation 2: mill mounting flange; drill, bore, chamfer and tap speedometer hole complete; drill, chamfer and tap two inspection cover holes.
- ★ 125 pieces per hour at 100%.
- ★ Features: J.I.C. standard construction; power operated indexing trunnions; fluid motor drive for indexing; single point tool for cross-facing flange of large end.

Except for finish bore

Established 1898

THE CROSS CO.

DETROIT 7, MICHIGAN

Special MACHINE TOOLS

Designing Pattern Dies for Investment Casting

By Rawson L. Wood
PRESIDENT
ARWOOD PRECISION CASTING CORPORATION

AND

Davidlee Von Ludwig
CONSULTANT

Part I

THE INVESTMENT CASTING process is used to produce small, intricate metal objects to close dimensional and metallurgical specifications in quantities which vary from a few pieces to many thousands. All of the alloy groups may be cast with comparative ease. The relative difficulty of shaping the alloys by alternate casting or hot forming techniques and the machinability of the metals are factors which seldom apply when selection of a material to be investment cast is being considered. Without regard to the alloy composition, except insofar as foundry performance factors must govern the finest details of production, investment castings are held to dimensional tolerances which are unequalled by other hot forming or casting methods.

Most investment castings made for commercial purposes are modifications of designs which formerly were fabricated by other processes. Many parts formerly were assembled from a few or many sub-components. There are examples of single investment castings which, through correct redesign, replace assemblies composed of 20 or more constituents. The units in the assembled parts were semi-finished by stamping, pressing, forging, casting, coining, screw-machining and other machining operations. While the investment process seldom competes on parts which may be formed on automatic machine tools in single setups, it often does compete in producing parts requiring multiple setup operations or assembly of several components.

Fig. 1. Approximate parting line is worked in plaster prior to casting first half of Cerrotru pattern die. The round and rectangular bars will be draw cores.

Design engineers are increasingly cognizant of the potential afforded them in detailing small, complex parts for investment casting. Tool and die engineers are therefore being confronted with increasingly more complex parts which must be introduced into dies for manufacture of the patterns required to produce the investment molds.

The metallurgical and mechanical design limits of dies for making wax, plastic or frozen mercury patterns are completely different from those which apply to forging, pressing or die-casting dies. The toolmaker has a comparatively unlimited choice of materials from which to fabricate the die. In practice a few easily worked alloys have been found adequate for most pattern die applications.

The mechanical details of wax pattern dies are particularly different from those employed in any die intended to process hot or molten metals. Wax pattern dies may be freely considered for the optimum location of the parting line or lines and for the utilization of the most effective and simple techniques for separating and reassembling the die components to produce the maximum number of waxes with least distortion. Any desired combination of

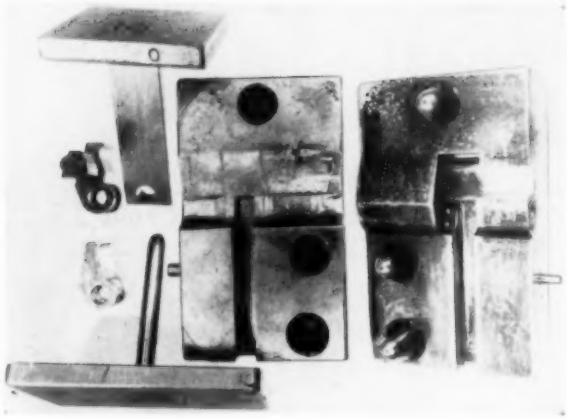


Fig. 2. Finished Cerrotru die for wax pattern production of steel ratchet dog casting. Gated wax pattern appears by original steel master die.

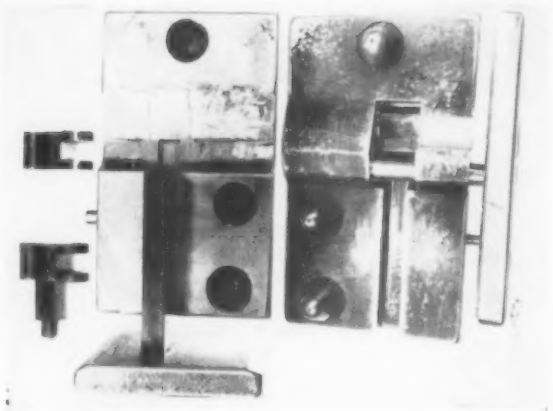


Fig. 3. The draw cords are shown in their respective places in the die. This is a typical single parting soft metal die for a small part.

springs, cams, levers, gears and the like may be directly incorporated into the die sections to aid in formation of the unstressed fragile patterns.

Precise air control within the pattern die structure is possible because the operation is standardized at or near room temperature for the production of most wax or plastic patterns. Special mechanical problems encountered in design and operation of mercury pattern dies are unique and solely due to the necessity of working the tools at from 100 to 135 deg minus Fahrenheit. As the majority of dies are made for wax or plastic, special attention to the mercury die requirements will not be detailed. Other than the low temperatures required, the most important other design consideration pertains to the ease with which mercury amalgamates with most metals. Steel does not alloy with mercury. Therefore it is used for almost all mercury pattern dies. Some success has been encountered in electroplating chromium on soft metal dies to avoid amalgamation.

Hot Metal Requirements Lacking for Wax

Use of disposable patterns to form essentially monolithic investment molds of plaster (gypsum) or ceramic (silica) bases avoids the temperature, chemical and metallurgical limits which apply where the dies are intended to work hot metal rather than wax or plastic. Location of parting lines, cores, inserts and other die details required to impart necessary design details to the patterns may be determined purely on the basis of maximum ease of freeing patterns from the die cavities. Therefore details may be imparted to waxes which could not be attempted by forging or die casting.

Two types of pattern die materials are commonly employed. For intricate, short run, development or trial castings, the dies usually are made from soft, non-ferrous low melting alloys. These fall into two groups. Those based on tin-lead-bismuth-cerium and antimony are the most commonly used due to their low melting range, their low solidification shrink rates and the ease with which they are processed. The second group of soft alloys are based on zinc. These are harder and various compositions such as Kirksite are comparable to mild steel dies in serviceability. They occupy an interim position between soft metal and steel dies. Most long production runs are made with steel dies. These usually are made from free machining grades of low carbon steel. Most pattern dies are used unhardened.

Selection of the proper die material is governed by the following details: 1) the pattern material to be formed; 2) the intricacy of the pattern to be produced; 3) the functional details of die such as number of parting lines, loose pieces, draw cores, mechanical members such as cams, springs, etc.; 4) the intended production volume required. The fourth factor dictates whether one or a number of cavities will be required, whether if the die is of steel, it will be used soft, with working sections case hardened, with all parts case hardened, or, in extreme instances, with the die sections made from hardened tool steels rather than carbon steel.

Waxes Differ for Patterns

Wax patterns are most commonly used. There are numerous waxes compounded from natural or synthetic materials. The different blends are used to solve varying pattern problems. The waxes differ widely in their hardness at room temperature, their softening points, shrinkage rates, stability and mechanical strength. The only factor which concerns the die maker is that of the solidification and cooling shrinkage rate. This is one of the variables which must be calculated in laying out the exact dimensions of the die cavity.

Wax patterns are easily produced. The tempera-

tures used to soften the wax for injection seldom exceed 200 deg F. The die temperature usually is standardized at or near 70 deg F. The injection pressure is seldom in excess of 300 psi. Therefore the wax die may be held to minimum mass consistent with ease of manipulation. Most wax dies are partially or totally hand-operated. While this is not as rapid as machine operation, it permits complete freedom of location of cores, parting lines, injection gates and other details. For this reason maximum intricacy in the pattern and resulting casting is obtainable. Although waxes are more costly than plastics, they must be used to produce the majority of designs which are investment cast.

Pressure Is Consideration

Various plastics such as polystyrene are used to produce patterns of small uniformly sectioned parts which may be produced in single parting dies. Higher injection temperatures and pressures are used to form plastics than are required for waxes. Die locking pressures may be ten tons or higher. Therefore plastic dies usually are steel. Free machining low carbon steel is commonly employed. The guides, ejector pins, cores and other parts subject to friction wear usually are case hardened. Mechanical requirements of the plastic injectors establish the basic external dimensions of the die. Usually it is not considered feasible to include manual or automatic cores which must operate in planes other than that of the parting or perpendicular to it. Some producers have injection machines which permit more flexible location of cores, but most commercially designed plastic machines do not lend themselves to complex core problems.

Occasionally plastic dies are designed which employ loose piece cores to form requisite details. These slow down the time cycle of the machine and tend to raise the price of the plastic pattern to the same cost as the equivalent wax pattern. The chief advantage of plastic patterns over waxes lies in the superior mechanical strength of plastic. This permits free handling and storage of plastic patterns with little concern over breakage, distortion or warpage.

Numerous attempts to develop low melting metal alloys for investment pattern purposes have failed. Frozen mercury is the only commercially important metallic pattern material. Mercury is not competitive in either wax or plastic where the size and design are such that satisfactory patterns may be made with wax or plastic. Most designs requiring mercury patterns involve larger masses, heavier sections or special details not easily formed in wax or plastic.

Intricacy Dictates Pattern

Design intricacy of the part determines how many parting lines, cores or loose pieces must be provided to make the wax with minimum distortion. The closer the tolerances are specified, the greater the anticipated production volume, the more essential it is to use steel for the die. This is especially true when the die is to consist of several components or to require numerous small moving members. Multiple section dies of soft metals such as Cerrotru are made for production of 5,000 or fewer patterns. These dies must be designed so that all parting line edges include at least a 90 deg angle and are not run out to sharp or projecting radii. The life of the die is measured by the rapidity with which the edges are distorted to give rise to flash at the parting line. Formation of flash around core holes due to friction wear of the core in its guide also is a limiting factor in die life, although usually it is possible to repair the cores or core guides to eliminate flashing when the balance of the die is sufficiently sound to warrant the repair. It

Fig. 4. This single parting Cerrotru die typifies simple pattern die for producing a casting which would be difficult to fabricate otherwise.

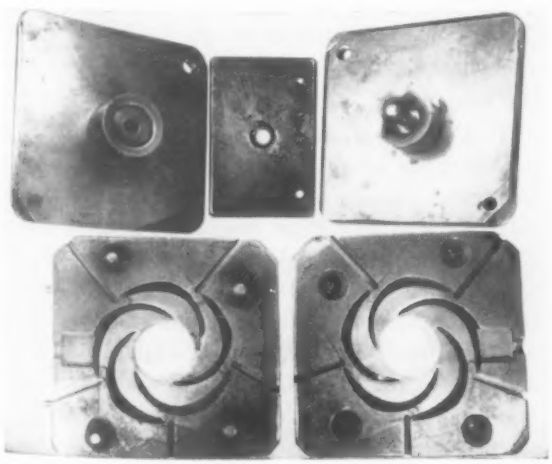
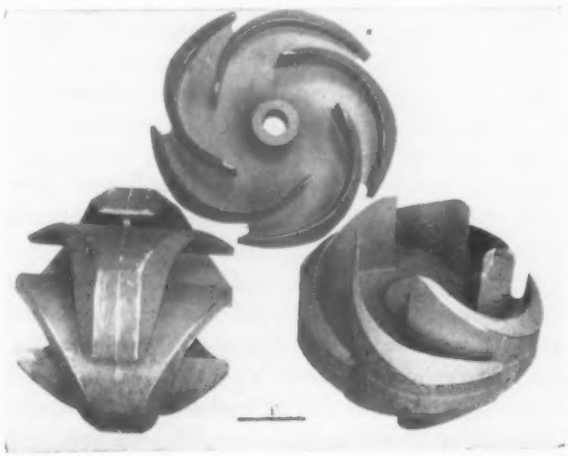


Fig. 5. Fuel impeller castings from 356-T-6 aluminum produced in quantity from patterns made in the single cavity Cerrotru die.



is essential to avoid sharp angles and fine projections which may be abraded, bent or broken.

The life of a pattern die is largely governed by the care used in designing, constructing and operating it. The inherent limits of the material used to make the die will usually set a maximum service life which will be approached only as a result of a proper design and operation. The stronger the die is as a result of good design practice and correct materials utilization, the longer the die life will be. A greater yield of uniformly dimensioned patterns is obtained from well constructed dies than from those carelessly made.

Trial Run Castings

Most trial runs of investment castings are made from patterns produced from Cerrotru or Cerrocast dies. Such dies are so easily made and so much less costly than most production tools that it is often desirable to make the single cavity soft metal die to check and refine the part design before making the final pattern die for quantity production. The single cavity soft metal die may be used for trial and for semi-production quantities up to 10,000 patterns while production run tools are being produced. This technique for trial development runs of investment castings is also employed to obtain performance tests on products which ultimately are mass produced by forging, die casting or even, occasionally, by automatic machine tool techniques.

Quantities On Increase

Production quantities for industrial products being investment cast are increasing, exceeding the 10,000 unit life of one or two cavity Cerrotru dies. Where the parts include intricate curvatures which would be difficult to machine sink into steel, it is necessary to make 5, 10, 20 or more cavities in the soft metal die to produce quantities in the order of 100,000 patterns or more. The multiple cavity soft metal die is most easily made by using multiple master patterns. The duplicate masters will be functionally identical although they will inevitably differ slightly in absolute size and finish. Where the patterns must be absolutely identical it is necessary to sink the required number of cavities individually from the same master pattern, then mount the resulting small cavities in a support and provide a common runner and gating system. Patterns made from such dies are indistinguishable from one another.

If the design is such that it may be readily hobbed or machined into steel it is usually preferable to make a multiple cavity die in steel. The permanence of steel is so much superior to soft metals that runs of 100,000 units from a single cavity in an unhardened carbon steel die are common. Case hardened steel dies produce in excess of 500,000 units. Obviously these quantities are multiplied by the number of cavities imparted to the die. Multiple cavity steel dies are therefore used for maximum volumes of wax or plastic patterns. These dies have practically unlimited life, particularly where the movable portions subject to friction wear are properly hardened. Usually the designs which are suited to multiple cavity dies are small and not too intricate. Plastic patterns can only be made where the parts are of uniform section and do not entail deep draws to free the patterns for ejection.

Weight Consideration May Alter Selection

Use of metals other than steel and soft alloys seldom is necessary. Aluminum or magnesium sections sometimes are used to reduce weight in large manually operated wax dies. Some investment foundries have made entire dies out of aluminum, magnesium or brass. There is little purpose in machining cavities into these materials. Their life is not as great as carbon steel and the difference in machinability is a negligible factor in sinking the die. Several shops make use of brass insert cores to avoid the necessity of introducing draw cores in planes other than along the parting lines. This is done to minimize the necessity of making multiple parting dies as well. The accuracy of the wax patterns formed in dies which incorporate loose inserts of brass or other metals is open to some question. It is better to provide draw cores which may be removed while the fragile pattern is supported by the body of the die, rather than to use loose pieces which must be removed from the pattern after it is ejected from the die.

The position occupied by the disposable pattern in the sequence of casting operations is unique. Except for the necessity of calculating the shrinkage in the final cast object, the alloy which is to be formed may be disregarded in laying out the die. In using patterns for trial or development work it often is possible to cast widely differing alloys which have approximately the same or similar shrinkage rates with negligible effect on the size of the final part.

Tool designers must not consider the pattern die on the basis of practices requisite for producing hot metal casting or forging dies. The potential intricacy and operation flexibility is seriously inhibited where such unrelated practices are allowed to influence the development of the pattern die. Several major investment foundries are making castings from dies which are seriously underdesigned as a result of adherence to inapplicable tool and die production techniques inherited from forge or die casting ideas.

Raising the Limits on Carbide Machining

By W. P. Coomey

GENERAL SUPERINTENDENT
RICE BARTON CORPORATION

How fast can we machine with sintered carbide cutting tools today?

Most manufacturing plants seem, at the present time, to believe that optimum carbide machining speeds, cutting mild steels, may have to be as low as 200 sfm, with about 800 sfm as maximum.

Higher machining speeds together with proper feeds, are desirable for more reasons than just the saving in operations time—decisively important through time saving is:

(1) The finish on product is improved.
(2) Required power is reduced, hence
(3) Greater CIM metal removal can be achieved on existing machine tools.

Again, what are the upper limits in carbide machining speeds? In a slotting cutter test, to be subsequently described, run at a surface speed of 1435 sfm, at 0.020 in. chip load on SAE 1030 steel, was achieved with complete success. Other currently published data show speeds that are comparable with this figure, considering the variables of the work, the cutting tool, the machine tools, and other factors. The following influencing factors will be separately considered:

(1) The optimum work-face temperature
(2) The optimum speed-feed-cut combination
(3) Critical cutting tool design
(4) Cutting tool grind and finish
(5) Machine tool variables

(1) Optimum Work-Face Temperature. It has been determined, in several series of reliable tests, that there is probably a critical range of speeds and feeds, for any given work material, that will leave the tool and the work cool.

A prominent New England tool builder recently conducted a series of tests to determine chip temperatures actually reached during machining. From past experience in the heat treating of hardened parts, it was known that as the temperature increases above 400 deg F, the workpiece first shows a light straw color, successively changing through browns to blue and, ultimately, a purple color.

Speeds Heat Chips

Calorimeter tests indicated that chips produced at high speeds attained as high a temperature as 800 deg F during actual machining. However, examination of these chips upon completion of machining showed their color to be very similar to that of chips cut at extremely low speeds, i.e., they showed no discoloration whatever. However, heating these same high-speed-produced chips to 800 deg F in a furnace, caused them to show an entirely different appearance, showing an over-all purple color. These tests would seem to indicate that the chips do actually pass through this high temperature range during machining, but they pass the range so rapidly that their surface color is not materially changed.

(2) Optimum Speed-Feed-Cut Combinations. A test was run in the Rice Barton plant, using an 8 tooth slotting cutter, 3/4 in. wide and 6 in. diam., with carbide tips brazed to a solid steel body. The cut was climb milling, 1/2 in. cut in SAE 1030 steel which was 2 in. thick by 8 in. wide by 36 in. long.

Using 0.020 in. chip load at 1435 sfm, five separate passes were taken, the machine was stopped,

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and it was discovered that both the cutter and the work were still at room temperature.

Using the same data, but only reducing the chip load to 0.002-0.003 in., the cutter and the work were both found to be so hot that they could not be touched.

From these tests, it is evident that ultimate carbide tool life is attained when, with the proper feed (or milling chip load), the speed is high enough to prevent all heating of the work and the cutter.

(3) Critical Cutting Tool Design. At maximum carbide machining speeds, it is doubtless true that tool design will be critical, whatever type the tool may be. Here, emphasis is placed on the necessity of extremely accurate tooth spacing in milling cutters.

Spacing Flaws Set Up Vibrations

At maximum operating speeds, any persisting tooth-spacing inaccuracies will set up supplementary or transient superimposed vibrations.* These arise from the fact that the combination of vibrating elements, namely, the machine, the workpiece, and the cutter, cannot follow the natural frequency that would be established by the cutting process alone.

As an example, if an 8 tooth cutter were run at 1000 rpm, there would be 8,000 tooth-impact impulses per minute. This frequency might be so high as to preclude the machine or the workpiece itself from following this inherent frequency. As a result, a much lower frequency, possibly one-fourth to one-ninth the basic frequency, would be established in the system.

Vibration Frequencies Vary

Physical laws show that heavy masses, such as a milling machine with mounted workpiece, do not vibrate at high frequencies. By accurate cutter-tooth spacing, there will be little to no tendency for the combination of workpiece, machine and cutter to operate at any of the lower frequencies. Therefore, with accurate cutters, there will be practically no vibration. It is only when both frequencies of heavy magnitudes are encountered that a workpiece and heavy cutters and machines will follow.

When Rice Barton began milling at high speeds, repeated failure was experienced on one carbide tip on a face mill. In some runs, this same one tooth had to be replaced as many as six times. Careful examination revealed that the spacing of the teeth varied as much as $\frac{1}{23}$ in. At normal milling speeds, this difficulty did not arise. To assure accurate tooth spacing, and thus eliminate tip breakage due to increased impact at high speeds, a separate ratchet fixture was built for each of the different number of teeth in the various cutters used. The tool grinder operator would then index the cutter, registering on the ratchet rather than on the tooth face. Since this practice was initiated, there has been no milling cutter tooth failure at high speeds.

(4) Cutting Tool Grind and Finish. Since ultra-high carbide machining speeds are a very recent and rapidly changing development, tool angles for such speeds are themselves as yet in the cut-and-try stage. The best probable practice is to work away from the angles generally accepted for the slower speeds, toward angles evidently adapted to the particular application. A 6 deg positive angle that works well on one material, may not on another material. It is suggested that, in the machining of the more ductile or stringier metals, the top rake angle be increased toward the positive. If the material seems to have an affinity for welding to the tip, keep increasing the angle toward the positive until the welding action is eliminated.

Finer Grit Tends To Strengthen Cutter

In the earlier high-speed tests, normal 60 grit wheels were used in cutter grinding. Repeated chipping was frequent. As progressively finer-grit wheels were used, the high and low spots were more nearly eliminated on the cutting edges, which progressively approached a true straight line, and the cutter became stronger. Today, carbide tips are rough ground with an 80 grit diamond wheel, and finished with a 400 grit diamond wheel. In addition, fine diamond honing puts a 45 deg angle on the cutting edge, eliminating the small fine saw-tooth edges and producing a finish somewhat below five micro-inches.

Sharpening for Economy

When should a tool be sharpened?

It was previously stated that optimum machining conditions prevail when the tool and the workpiece remain at ambient temperature. Accepting that statement, it is logical to suppose that tool wear has become objectionable when feeling the tool or workpiece indicates that heat has begun to be generated. The onset of heat in the machining operation, in the absence of other factors, is due to dulling of the tool, requiring more power that can only be dissipated in the form of heat.

Actually, it is best to sharpen cutters before heat

*Ed. Note: If the impulse applied to maintain vibration is increased only slightly, the amplitude will build up far out of proportion to the inciting cause, since the energy in excess of that needed to overcome friction is cumulative, and is in a sense continually stored up as increasing energy of vibration. Prolonged repetition of a small periodic impulse can thus produce very large superimposed vibrations. A comparison is the practice of having troops break cadenced step in crossing a suspension bridge. (Perkins, H. A., *College Physics*, Prentice-Hall, Inc., 1946).

indications appear. Frequent touching up of tools is the soundest economy.

(5) **Machine Tool Variables.** Today, there are available milling machines, horizontal borers, and other machine tools having speed, power and rigidity adequate for high-speed machining.

But the case is otherwise as regards available feeds. One make of milling machines has a maximum speed of 60 inches per minute; another provides 90 inches per minute. This is not sufficient. The fully successful performance of carbides at very high speeds demands the combinations of speeds and feeds that will result in all the heat entering the chips, and none in the workpiece or the cutter. Heat will inevitably enter the workpiece and the cutter unless the proper combination of feed (or chip load) and speed is found and maintained; high speeds alone will put frictional heat into workpiece and cutter.

Horsepower Consumed Varies With Feed-Speed

One effective proof of the optimum feed-speed combination, for a given operation, is the progressive reduction in consumed horsepower as the optimum combination is more and more nearly approached.

In one high-speed planing test, a $\frac{3}{4}$ in. depth of cut was taken with four heads, using 1/16 in. feed. At 100 fpm speed, 92 horsepower was consumed. Simply by speeding up the planer to 300 fpm, with the feed and the depth of cut unchanged, only 55 horsepower was consumed.

In a milling test with a 6 in. face mill, a cut 2 in. wide and $\frac{1}{4}$ in. deep was made at 0.020 in. chip load. At 200 fpm speed, 39 horsepower was required; at 375 fpm speed, only 31 horsepower was required.

In still another milling test with a slotting cutter of 6 in. diam. and $\frac{3}{4}$ in. width, climb milling at 0.020 in. chip load, 36 horsepower was required at 300 fpm speed but, at 1435 fpm speed, the horsepower dropped to 29.

Higher Speeds Needed

The above tests, and numerous others that could be mentioned, plainly point to the fact that we need higher and yet higher machine speeds and feeds than are generally available.

Furthermore, the need is urgent for infinitely variable drive of the feed elements. This is needed, not only to provide rapid and exact approach to optimum speed-feed combinations, but particularly when it is desired to experiment with different tool angles. With standard feed boxes, it is impractical if not impossible to change the feed rates in sufficiently small increments to making cutting research of any real value. This is due partly to the fact that, once the machine tool has been stopped, it is difficult to resume the identical conditions under which the test was started.

Proper and careful grinding of carbide tools becomes point of economy since sharp tools give longer wear and better results. Dull tools heat quickly as more power is required with their use.

It is to be hoped that some enterprising manufacturer will strip the conventional feed box and gear box from milling machines and, instead, install variable-voltage drives, one for controlling feed and another for controlling speed. Such an improvement would eliminate the crude, inflexible gaps from one feed to the next, and from one speed to the next.

There are presently two commercially available infinitely-variable drives which adequately meet machine tool requirements. They are General Electric's Thymotrol and the Westinghouse Mototrol. Either equipment will provide variable speeds with an over-all ratio of 240 to 1. This permits a milling machine to feed in what is now believed to be a practical range of $\frac{1}{2}$ up to 120 inches per minute, or even from 1 to 240 inches per minute. The future possibilities are bright for this type of control equipment.

Evaluation of Protective Atmospheres for Tool Steels

By Lester F. Spencer
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LANDERS FRARY & CLARK

Part I

THE USE OF A PROTECTIVE atmosphere to prevent the formation of an undesirable surface reaction on tool steel compositions during thermal treatment has often been a source of discussion which has yielded very little in the way of practical information for the average heat treater. In many instances, the subject of atmospheric protection has resulted in confusion and uncertainty as to the practicability of this tool for tool steel annealing or hardening processes. A discussion of this subject would naturally lead to questions such as:—'What is a protective atmosphere?'; 'What suitable means are there available to obtain this protection?'; 'When is atmospheric protection necessary?'; and, 'How can one determine the efficiency of a protective atmosphere?' An attempt will be made to clarify 'protective atmospheres' in regard to its use for the thermal treatment of tool steels.

A protective atmosphere can be defined as a medium which surrounds the work to be heat treated and serves in protecting the surface of the material treated from such surface reactions as is manifest either by carburization, oxidation or scaling, and decarburization. This protective medium can be either a packing material, which is very widely used in either pack annealing or pack hardening procedures; the immersion of the work in molten neutral salts; the use of a carbonaceous muffle such as is employed in the Sentry furnace; the use of a specially prepared atmosphere, usually produced separately from the heat source, which is directed into an air tight furnace; or even the commonly used 'borax coating' method in protection of steel surfaces. Each method has its limitations either in protection of the surface; the stability of the protecting medium; or, economical factors—these limitations being judged in view of these factors as (a) the type of tool steel composition to be thermal treated which in turn will govern the heat treating temperatures to be employed; (b) the quality factor expectancy which will be governed to a large extent upon the design of the specific die, its end use, and the life expectancy; and, (c) economic factors such as volume of tool or die work to be performed, labor costs, etc. Any one or a combination of the above mentioned factors may justify the expenditure of good furnace equipment and/or equipment which will produce satisfactory atmosphere protection.

The surface reactions that may occur during thermal treatment may manifest itself in the form of scaling, decarburization, or the addition of elements such as nitrogen and/or carbon to the surface of the material. In the latter instances, the wilful addition of either carbon and/or nitrogen increases the surface hardness of the die which is accompanied by an increase in brittleness; the use of which is confined to applications where extreme high wear resistance is desired. It is also understood that surface treatments which add elemental components to the surface of the tool steel cannot be employed where any degree of shock may be experienced during the life of the die. Thus, both the high-speed steels and the tungsten chisel steel can be commercially carburized to increase substantially their wear resistance. With the die irons, the carbon of which is very low to facilitate hobbing, carburization is of necessity in order to obtain the required wear resistance and realize good life expectancy. Nitriding has been performed successfully on such compositions as the high-speed steels, the high chromium-high carbon steels, and the hot working die steels such as is employed in the aluminum die casting field. However, since applications are specialized rather than the rule, these processes mentioned can be considered of minor importance.

The susceptibility of a tool steel to decarburize

would depend primarily upon its chemical composition. Thus, tool steel compositions containing high percentages of such elements as silicon, cobalt, and molybdenum show a greater tendency toward decarburization than steel containing other alloying elements. In high-speed steels which contain these elements, the tendency to decarburize is accentuated due to the high heat treating temperatures necessary for hardening. Nickel also contributes to decarburization especially when it is present in high-speed steel compositions. The very high carbon steels such as the high carbon-high chromium series show a greater tendency towards partial decarburization which is primarily due to the extremely high carbon content within the analysis.

Decarburization Causes

In the subject of decarburization, the formation of this undesirable product cannot always be traced to heat treatment practices. Thus, an incoming bar or billet stock may have a certain amount of decarburized skin or 'bark', a term which is often used to describe this condition. Recommendation from many steel suppliers is that the soft skin be removed by machining, the recommended cuts are shown in Table I.

Table I—**Recommended Cuts for Soft Skin Removal**

Diameter of Bar	Allowances for Machining
1¼ in. and under	1/16 in. on the diameter
Over 1¼ in. to 3 in.	⅛ in. on the diameter
Over 3 in. to 5 in.	¼ in. on the diameter
Over 5 in.	⅜ in. on the diameter

Also, upon hardening utilizing the conventional heat and quench decarburization may affect the life of the die even after the 'soft skin' is removed from every accessible surface by grinding. Thus, in a blanking die having an irregular profile cut, it is usually impossible to remove the 'soft skin' in holes, and where the wall of the hole forms one side of a cutting edge, a burr on the stamping will result after a short time in service. Where it be a full or a partial decarburized skin effect, the value of the tool steel as a blanking die is not realized to the fullest extent.

The production of a scale formation as produced by an oxidizing atmosphere is generally dependent upon such factors as time at temperature, temperature of hardening, percentage of water vapor present within the atmosphere, etc. Generally speaking, oxidizing atmospheres will generally scale tool steels to an objectionable degree only at high temperatures, i.e., usually temperatures above 1700 deg F (4). The only exception to this statement is the 5 percent chromium, 1.35 molybdenum and 0.40 percent carbon, which, due to its relatively low carbon content and other features of its composition (4), can be hardened in an oxidizing atmosphere successfully, even though the heating range is 1850 to 1875 deg F. It is a fortunate circumstance that

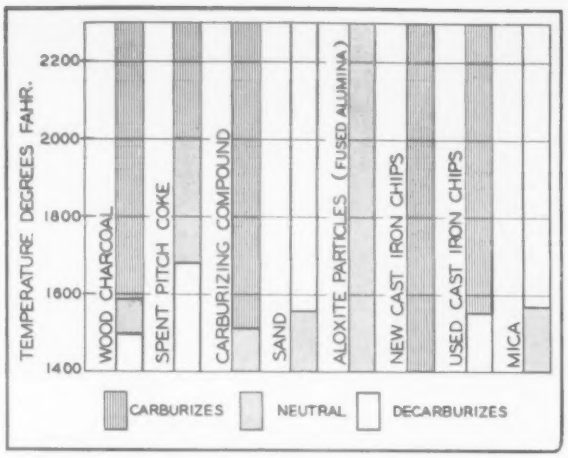


Fig. 1. Approximate range of usefulness of each of the principal packing compounds. Temperature of change from one behavior to another actually are not sharp. For cast iron chips, temperature below which decarburization takes place depends on carbon content of chips (5).

at relatively low hardening temperatures where a slightly oxidizing atmosphere is desirable in preventing decarburization, such atmospheres will not scale heavily, while at high temperatures, where scaling must be prevented by the use of reducing atmospheres, such atmospheres will not decarburize.

The use of an oxidizing atmosphere at temperatures of 2250 to 2350 deg F not only results in heavy scale formation, but also melts the scale after it is formed to give a greasy, glistening appearance which is often referred to as 'sweating'. Under severe conditions, this is accompanied by a boiling action and the scale accumulates in rounded blisters. Also, the production of a heavy scale formation may retard the cooling rate sufficiently so that neither the desired surface hardness or the depth hardness is realized. This is particularly true when the scale formation is extremely adherent; this condition being usually associated within a fluctuating atmosphere producing both oxidizing and reducing conditions within the furnace proper. This experience has been encountered on production annealing of stainless steels in an oil fired, hand controlled batch type furnace.

The formation of scale is endothermic in reaction and when present in sufficient amounts, an increase in the temperature of the steel being hardened above that recorded by the potentiometer may be experienced. Also, where atmosphere furnaces are employed, the presence of scale on the surface of the tool steel prior to entry into the furnace may lead to decarburization unless the atmosphere is highly reducing resulting in immediate decomposition of the scale.

Furnaces and Furnace Atmospheres

In general, the type of furnace that is utilized in the heat treatment of tool steels is the batch type.

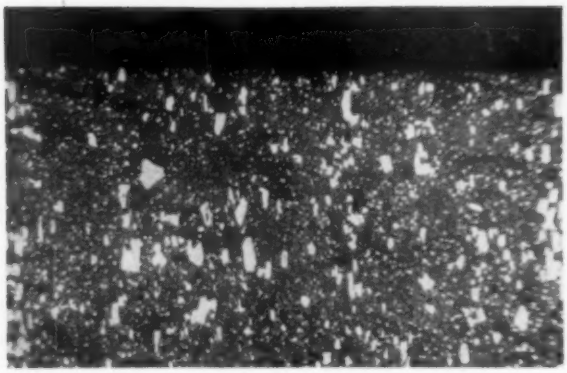


Fig. 2. Satisfactory edge structure. Steel Type A; air quenched from 1750 deg F, followed by a 450 deg F draw for two hours. X125

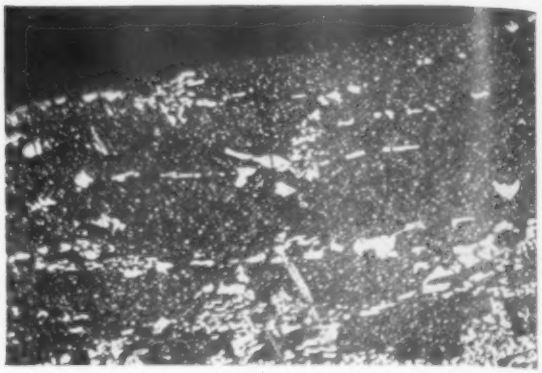


Fig. 3. Satisfactory edge structure. Steel Type B; oil quenched from 1850 deg F, followed by a 750 deg F draw for two hours. X200

however, in a few instances such as strip annealing of saw blade steel and in the hardening of razor blade steel, continuous furnaces can be employed. Since the batch type furnace is the more predominant type employed, discussion will be limited to that type of furnace.

The direct fired furnace utilizing either gas or oil as a fuel source, heats very rapidly and produces the largest amount of scale formation. Heating in such furnaces will require the greatest amount of care to avoid overheating due to impingement of flame upon the work and to minimize scale formation. They are also difficult to heat uniformly and control the temperature within the furnace chamber itself.

The gas fired semi-muffle furnace can be used with success if the type of tools being treated do not require complete freedom from either scale or 'sweat'. The use of an inspirator has been recommended (4) which can control to a limited extent the atmosphere within the furnace proper. Of interest is the use of either wood, soft coal or a gas torch within the furnace to estimate the percentage of free oxygen within the atmosphere. Details of this test will not be given, however, reference 4, pp 454-458 gives the complete description of the test. The oil fired semi-muffle furnace has the same limitations as the gas fired. In both types of furnaces, undue soaking at temperature should be avoided.

The use of the electric furnace equipped with a gas curtain has been used to a considerable success in the hardening of tool steels. Manometers, after calibrated, can duplicate the atmosphere desired upon suitable adjustment. The use of the pure carbon muffles as exemplified by the Sentry furnace are normally used for hardening at temperatures between 2100 and 2400 deg F, although they can be used at temperatures as low as 1700 deg F when properly baffled. These muffles generate their own atmosphere from partial oxidation of the muffle, producing a reducing atmosphere composed of approximately 34 percent carbon monoxide. It is probably a reasonably pure mixture of carbon monoxide and nitrogen. Experimental work with this type of atmosphere has been done; the results being in a later part of this paper.

Surface Protection Problem

A method of protection of surfaces of tool steel from either scaling or decarburization can be realized by the utilization of the pack method of hardening. This operation consists of placing the die in a closed metal container with an inert material such as lime, mica, washed sand, cast iron chips, etc., and then heating the entire pack to the hardening or annealing temperature. When thoroughly heated and soaked, the pack is opened and the die is removed and quenched. The high carbon-high chromium lamination dies, which are quite intricate in design and must maintain both accuracy in hardening and long life in service, are pack hardened. The pack annealing of the high cobalt high-speed steels is practiced, however, with this type of analysis, the addition of approximately 8 percent of rice size charcoal added to the inert packing material has been found to give good results. In any pack method, the container should be sealed in order to control the composition of the gases generated by heating of the mixture.

Of interest is the time factor in heating a pack utilizing different packing materials. In the experiment performed (4) a one inch diameter high carbon-high chromium composition was employed utilizing an electric furnace at a temperature of 1780 deg F. The results can be compared in Table II.

Table II—Heating Requirements Vary With Packing Material

Packing Material	Practically up to heat	Fully up to heat
New Charcoal—pea size and finer	1 hr, 30 min.	2 hrs, 00 min.
New Charcoal—larger than pea size	1 hr, 00 min.	2 hr, 30 min.
'Spent' Charcoal—pea size and finer	1 hr, 30 min.	2 hrs, 00 min.
New Clean Cast Iron Borings	1 hr, 00 min.	1 hr, 30 min.

Fig. 4. Satisfactory edge structure. Steel Type D; oil quenched from 2220 deg F, followed by a two hour draw at 1050 deg F. X200

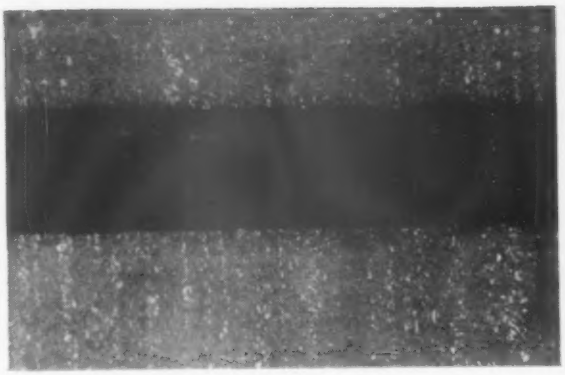


Fig. 5. Satisfactory edge structure. Steel Type E; oil quenched from 2230 deg F, followed by a two hour draw at 1050 deg F. X125

Cast iron chips can be prevented from sticking to the tool by wrapping the tool in heavy brown paper (4) before placing in the pack. The paper will char and practically disappear when the heated tool is removed for quenching, however, in the meantime, it will keep the cast iron chips from adhering to the surface of the tool.

Factors Vary Heat Rise

In pack hardening, it is expected that a container would come up to heat faster in a furnace that has a recirculation of combustion products such as either the gas or oil fired furnace as compared to an electric furnace. Another factor to consider would be the shape of the container; this being somewhat the same as would be experienced in the heating of solid sections of similar size. Carburization effect of the pack material used should be expected, this being a variable in accordance to both pack material and temperature of heating that is employed. As mentioned previously, the effect of carburization may be beneficial on items such as draw dies where the increase in hardness experienced would increase wear resistance, however, carburization would be harmful on a sharp corner of a blanking die. Thus, Luersson and Palmer (4) in an experiment on high carbon-high chromium analysis determined the effect of four packing materials. Their determinations, as listed in Table III, were obtained by chemical analysis of the first 0.007 inch layer obtained from the surface.

The effect of packing material is also illustrated in Fig. 6 (5), this being used just as a guide as the presence of scale, the age of the packing compound, the moisture content, the carbon of the steel packed, etc. will appreciably alter the range.

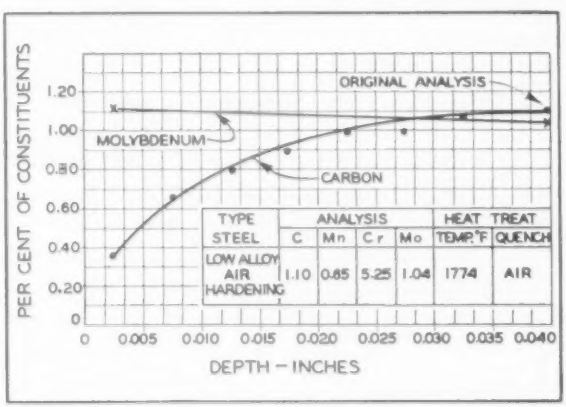
Table III—Effects of Four Packing Materials on High Carbon-High Chromium

Packing Material	Original Carbon within Steel	Surface Carbon after Packing	Gain
New Charcoal—pea size and finer	2.02%	2.45%	0.43%
New Charcoal—larger than pea size	2.02%	2.41%	0.39%
'Spent' Charcoal—pea size and finer	2.02%	2.29%	0.27%
New Clean Cast Iron Borings	2.02%	2.14%	0.12%

Controlled atmosphere furnaces may be of the complete muffle type heated by either gas or oil, or may be electrically heated, when no muffle is needed. In either case the atmosphere is provided from a source separate from the heating medium. These furnaces heat more slowly than any of the other equipment and can be controlled to prevent scale or 'sweat'.

Due to the expense of a purified hydrogen atmosphere and the difficulty experienced in maintaining its purity, this specific atmosphere is reserved for small production installations. It is used in applications where bright work is mandatory on highly alloyed compositions, however, it is a pre-requisite to remove all impurities from the gas prior to usage. With the removal of both oxygen and water vapor, a dew point corresponding to —100 deg F can be realized. Depending upon the source of the hydrogen, the cost of this atmosphere will vary from $3.00 to $10.00 per M cu ft.

Fig. 6. Method of plotting results from data obtained from analysis of consecutive cuts; shows total depth and degree of decarburization as well as effects of the atmosphere on constituents other than carbon on steel (2).



Ultrasonic Inspection Today

By H. E. VanValkenburg

ENGINEERING DEPARTMENT
SPERRY PRODUCTS, INC.

THE YEAR 1951 IS THE BEGINNING of a new stage in the application of ultrasonic testing techniques in industry. During the past ten years it has progressed from the state of embryonic concepts through a trying period of growth to become a useful and widely accepted tool. Now, with other modern inspection methods, it must serve the defense effort toward such clear objectives as greater production, decreased waste, improved reliability, and more effective design.

By cross-indexing a large number of publications, a comprehensive bibliography of articles directly related to ultrasonic testing has been accumulated. To suggest in outline something of the chronology as well as the topics covered, tabulations of these references have been made in Table I.

In reviewing these references, several facts were noted: (1) great universal interest in ultrasonic testing has occurred only during the last five years. (2) Its growth has paralleled that of closely related electronic techniques. (3) Almost all references to basic theory were extracted from other fields, some seemingly unrelated. Thus, ultrasonic inspection has been a product of instrumentation and application, without a corresponding integration with theoretical investigations and analysis. (4) All testing methods reported could be classified as one of three basic approaches—continuous transmission, thickness resonance or pulse reflection.

While these principles have been discussed in several survey articles, Fig. 1 is shown to clarify the division. Ultrasonic testing, as opposed to such low-frequency vibration methods as tapping, ringing and shaking, involves sending a well-defined beam of extremely rapid mechanical vibrations into solids to locate defects, and make measurements. The division noted above is determined by the manner in which this beam of ultrasonic waves is generated and indicated. In Fig. 1, (A), a continuous beam is allowed to travel through the specimen and is detected by a pick-up device on the opposite face. In (B), the waves are allowed to reverberate between the faces of the object, and a condition of thickness resonance indicated. In (C), reflections are obtained by directing discrete impulses of ultrasonic waves into the specimen.

In reviewing the references it was found that (1) Transmission testing was pioneered in Europe and not reported here until 1941; (2) Resonance methods have been developed and applied almost exclusively in this country; (3) The pulse reflection technique has been most thoroughly investigated here and in Great Britain, but is now in world-wide use; (4) Greatest interest recently has centered on this method, first disclosed in Dr. F. A. Firestone's patent application describing the Reflectoscope. This and other references, which suggested important new basic techniques or described new instruments, are tabulated in Table II.

It was proved early in the application of ultrasonic testing that the beam is intercepted by physical discontinuities of almost negligible thickness, the sensitivity of the method depending principally on the area of the defect. Instrumentation then became available which easily detected cracks, voids, laminations, etc. It was also determined that the beam penetration depended greatly on porosity, grain structure and inelasticity, but an accurate formulation of these effects, either theoretical or empirical, which is directly applicable to the materials encountered in industry has not appeared.

Although lack of quantitative data and of de-

Table I—References According to Technique

Period	Continuous Transmission	Thickness Resonance	Pulse Reflection	Total References
Up to 1935	7			7
1936 to 1940	24			24
1941 to 1945	20	5	3	28
1946 to 1950	28	18	95	141
				200

Presented at Annual Meeting, American Society of Tool Engineers, March 15, 1951.

tailed inspection specifications is partially attributable to the newness of the technique, other important aspects of the problem are worth mentioning. Suppliers of material have been reluctant to encourage extensive use of a new inspection method which detects previously undiscovered flaws in their product, and have been somewhat unwilling to publicize defects found. Manufacturers of finished equipment have applied ultrasonic inspection principally to incoming raw material to detect faults that would interfere with machining, welding, punching and other fabricating operations, without any extensive investigation of their effects on strength, growth of cracks and fatigue failures. Moreover, they have not released information which might be detrimental to any supplier. Where testing is being used primarily for preventive maintenance, the objective has been to detect cracks at the earliest stage, leaving little reason for detailed investigations.

For effective use of ultrasonic testing, as with other nondestuctive tests, it is essential that:

(1) All concerned, including the designer, understand the principles of the method.

(2) Practical standards be established, which are based on objective consideration of the capabilities and limitations of present techniques, correlated with metallurgical specifications.

(3) Interchange of pertinent non-classified information through literature and technical society be expedited, even though company policy would oppose its release in normal times.

So that the best approach to a given problem may be suggested, Table III offers a more detailed classification of basic principles.

In general, there exists in each type of test a wide range of frequencies, and sensitivities, and alternate procedures or modifications such as:

(1) Transducer contact with sample, or immersion in liquid, curved adapters, etc.

(2) Beam directed straight in, or at an angle to surface.

(3) Ordinary compressional waves used, or special types such as shear or surface.

(4) Use of a direct indication, or absence of resonance, back reflection, etc.

(5) Manual or mechanical scanning of the sample.

(6) Visual or semi-automatic indications.

There exists at present no quantitative information on the ultrasonic behavior of commonly used materials, nor any generally accepted specifications for inspection. While there is some activity along this line in certain fields, it has not become handbook data. In addition, there is considerable divergence between the apparent interests of the supplier, designer, fabricator, quality control man and others.

Table II—Chronology of Techniques and Instrumentation

Date	Subject	Author & Bib.	Reference
1929	Early application of ultrasonic transmission to testing	S. Sokoloff	Elektr. Nachr. Technik
1931	Various arrangements for detecting internal faults using an ultrasonic beam	O. Muhlhauser	v 6 (454) 1929 Application for German Patent—#569,-598 (1933)
1939	Ultrasonic testing using an acoustic image technique	R. Pohlman	Z. f. Physik v 113 (697) 1939
1940	Reflection testing using discrete wave-trains of ultrasonic energy	F. A. Firestone	Application for U. S. Patent #2,280,226 (1942)
1944	Instrumentation for resonance testing—the Sonigage, Reflectogage, etc.	W. S. Erwin	Application for U. S. Patent #2,431,233 (1947)
1945	Delay methods for close-in testing including the solid "Technozzle," liquid immersion, etc.	F. A. Firestone	Application for U. S. Patent #2,467,301 (1949)
1947	Angle beam testing using the solid wedge for wave conversion	B. Carlin	Application for U. S. Patent #2,527,986 (1950)

General Features of Ultrasonic Inspection

Mechanical Phenomenon. The ultrasonic waves used in nondestructive testing are essentially low-intensity high-frequency vibrations which propagate easily through elastic homogeneous solids. From the laws of mechanics such properties of the beam as velocity, mode of vibration, reflection and refraction at interfaces, and beam spread, can be predicted. Moreover, such effects as resonance, wave mode conversion and subsidiary reflections, can be explained and utilized. As a result, it can be applied to the detection of internal flaws, the measurement of thickness, and the determination of elastic constants. Non-mechanical properties such as color, permeability and chemical composition, can be indicated only to the extent that they affect the elastic behavior of the material. Moreover, since the vibrations are of low amplitude, the material is not appreciably stressed; therefore such effects as plastic flow or fracture of weak bonds do not result. Thus, such conditions as "paste" welds, "incipient" laminations and low-strength electroplating are not generally detected, unless pre-stressing can be applied to cause a true mechanical discontinuity.

It must be emphasized that any indications obtained from within the sample must be caused by actual physical discontinuities, and by sectioning and proper metallurgical procedures they can be verified. This results in the serious problems of differentiating between so-called "harmful" defects and "non-injurious" discontinuities, and in establishing acceptable limits of defect size.

Penetration. In the non-porous elastic materials used in structural components, such as steel, aluminum, magnesium, glass and porcelain, the ultrasonic beam travels several feet before it is greatly

Table III—Analysis of Ultrasonic Inspection Principles

Type of Ultrasonic Beam Used	Transmission Through Object	Thickness Resonance	Reflection of Pulses
Continuous Waves (Unmodulated)	—	Tunable Sonigage	—
Frequency Modulated Waves	(1) Metered Output (2) Acoustic Image	Automatic Sonigage (Reflectogage, etc.)	—
Pulsed Wave-Trains	(1) Metered Output (2) Time Base (2 Crystal Reflect. Time Interval Meters, etc.)	Tuned Reflectoscope	(1) Single Crystal Reflectoscope (2) Two Crystal Reflectoscope (H. Hughes, etc.)

attenuated. Thus, flaws far below the surface and beyond the range of any other nondestructive test can be detected and located. In non-elastic materials such as lead, porous materials such as brick, and large-grained materials such as cast iron, excessive dissipation of the beam may prevent testing.

Practical Signal-to-Noise Ratio. Present instrumentation is satisfactory both as to frequency and sensitivity to achieve a satisfactory signal-to-noise ratio in the common structural materials. That is, random indications due to minute discontinuities scattered throughout acceptable material are much smaller than those of the defects to be found. Where this is not true, testing becomes difficult or impossible, and cannot ordinarily be accomplished by decreasing the sensitivity or lowering the frequency, since the ability to detect a flaw of given size is correspondingly impaired.

At the present time, ordinary plate welds are considered to be in this category, since grain structure, inclusion content, and acceptable porosity produce high noise which will mask a small crack. Applications can be expected in quality welds used in highly stressed components where such discontinuities must be minimized.

Highly Directive Beam. Because of the high frequencies used (from a hundred thousand cycles per second up to ten million or more) the beam can be restricted to a cone of a few degrees, and of an inch or less in cross section. This can be done with small transducers, permitting location as well as detection of defects. Beam directivity is sometimes a limitation in testing, either because the critical area is blocked by a re-entrant section, or because defect orientation will not result in a reflection.

Instantaneous Indication. Due to the electro-mechanical nature of ultrasonic equipment, its response is essentially instantaneous. Signals are obtained as soon as the transducers are applied to the specimen, without the necessity of radiation protection, pre-magnetization, ultraviolet light, and photographic exposure. Moreover, the entire volume of material below the surface of inspection is tested at once, since the beam ordinarily traverses the entire length of the sample. Therefore, by scanning only one end of a shaft its entire volume can be inspected.

Convenience of Operation. Surfaces usually encountered are satisfactory for testing and require only the application of a film of coupling oil for transmitting the ultrasonic vibrations from the transducer into the specimen. Such obstruction as loose scale and rough paint must be removed with a surface grinder to allow penetration of the beam.

Ordinarily, access is required to only one face for the resonance or pulse reflection methods, and with the most commonly used equipment only one small search unit is necessary. A wide range of angle beam, immersion, and other techniques can be employed to suit the contour of the specimen. The instrumentation is well adjusted to industrial testing, and can be easily transported to the sample for "in-place" inspection. One type of ultrasonic device is completely portable, being operated with self-contained batteries. Difficulties may result from excessive curvature, re-entrant sections, and composite construction, which interfere with the application of the search units or with the path of the beam through the specimen.

Versatility. As suggested by the references cited and by the features outlined, ultrasonic techniques can be applied to a wide variety of testing and measuring problems. Flaws can be detected and located in such varied specimens as small aluminum forgings and 50-ton steel rotors. Wall thicknesses of from 0.020-in. up to the heaviest used can be measured in plate and piping. Limitations usually involve either metallurgical properties or dimensional features.

Potential applications include the study of elastic properties, determination of physical constants, control of metallurgical properties and use as a quality control technique. Moreover, an ever-increasing number of applications can be expected in the already established fields of industrial flaw detection and preventive maintenance.

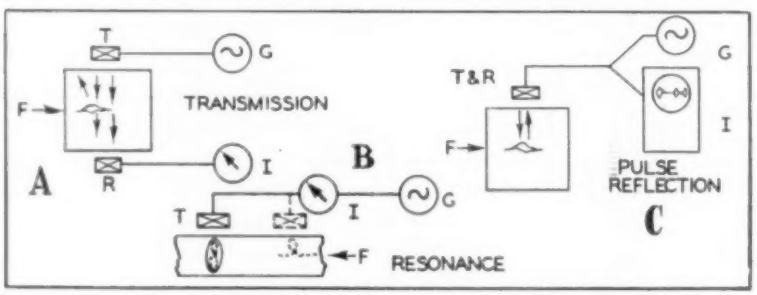


Fig. 1. Schematic diagrams illustrate the three basic methods of ultrasonic testing—transmission, resonance and pulse reflection. *T* represents transmitter; *R*, the receiver; *G*, wave generator, *I*, indicator, and *F*, deflection. In (A), continuous beam travels through specimen; in (B), waves reverbrate between faces and condition of thickness resonance indicated; in (C), ultrasonic wave impulses directed into the specimen are reflected.

Nomograph on Flow of Viscous Fluids

The Hagen-Poiseville Law for Determining Pressure Drop in Laminar Flow of Viscous Fluids in Circular Conduits

By Leonard M. Majeske

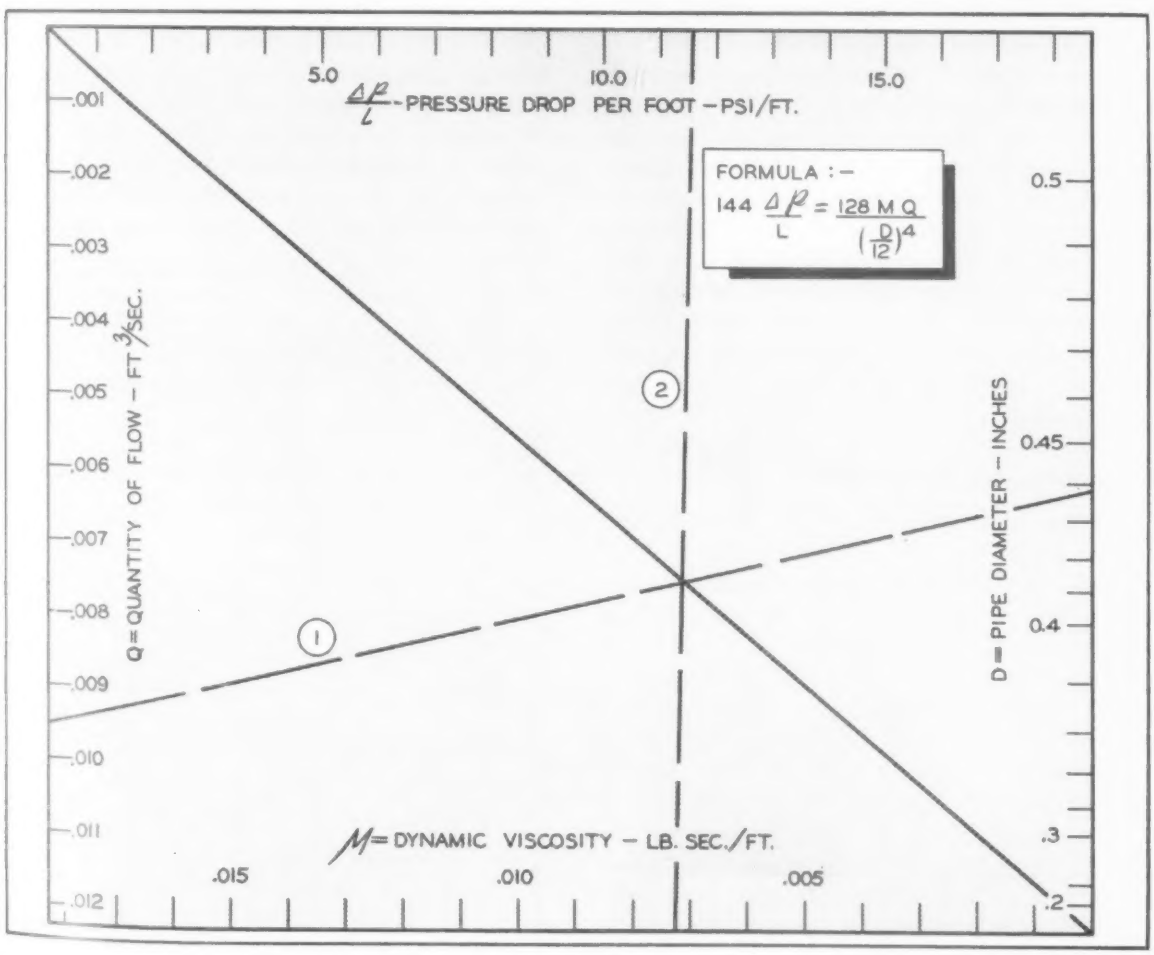
THE NOMOGRAPH SHOWN below may be used by designers of turret lathes, milling machines, grinders, fluid machinery and all other types of machinery where the flow of a viscous fluid is involved. For example, flow of lubricating oils, or flow of coolant oils for machining purposes, are typical applications.

This nomograph gives the pressure drop in the line in terms of psi per foot of length, when the pipe diameter (D) is known, the quantity of flow in cfs is known and the viscosity of the fluid in engineering units of lb-sec per sq ft is known.

Sample Calculation:

Pipe Diam (D) = 7/16 in. (.4375) ID
Q = Quantity of Flow, .0095 cfs
Viscosity of fluid, μ = .0075 lb-sec/ft^2

Draw 1 connection D and Q. Draw 2 connecting μ and intersection of reference line to intersect $\Delta p/L$ scale at 11.45 psi/ft pressure drop.



A New Clamping Device for Jigs and Fixtures

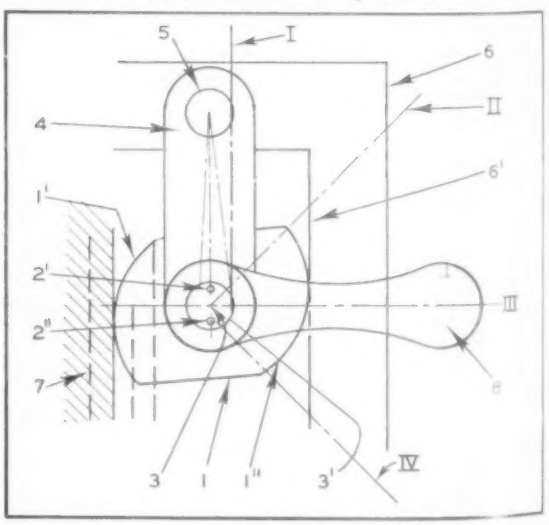
By P. Grodzinski

SOME YEARS AGO the writer tried to evaluate the forces acting on eccentrics of the usual design and realized that practically the same forces which act on the clamping face were acting on the pin. In the total friction force for making this element self-locking were contained the friction force around the pin of relatively small size (about 1/3 that of the cam periphery). It occurred that in order to increase the friction forces it would be necessary to increase the pin radius practically to the radius of the cam face. After this consideration it became clear that this opposite face need not to be a pivoting, but could be a cam face itself. This led to the *double eccentric*. Since this device has no fixed pivot, an arrangement had to be made to secure that the cam could not move sideways, and for this purpose its suspension on a swinging lever or guidance by a pin was suggested (Brit. Pat. 554,147 P. Grodzinski).

Explanation of Principle

The double eccentric cam *1* is limited by two circular arcs *1'* and *1''*, the centers *2'* and *2''* of which are displaced by an amount *e'* from the actual center *3* of the cam, each arc extends through an angle between ± 45 to ± 60 deg from a line perpendicular to the connecting line of the centers *2' 2''* so that each circular face covers an arc of between 90 to 120 deg included angle. The cam is suspended in its center *3* which is formed into a pivot *3'* for a swinging lever *4*, the other end of which is suspended in pivot *5* in the base *6* of the fixture. One circular face of the cam abuts against a fixed part *6'* of the fixture, the other against the workpiece or any intermediate piece *7*. The cam is provided with a hand lever *8* rigidly connected to it or detachable and pivoted on the same center *3* as lever *4*. When the cam is actuated by lever *8*, the center of the cam is caused to move in an arc, the radius of which is given by the length of lever *4*. Four extreme and important positions of the lever *8* are indicated. In position I the cam is free and there is clearance between cam and workpiece for the unhindered insertion of the latter. If the lever is brought from position I into position II the clamping action begins if the workpiece is oversize, whereby one side of the cam is pressed against the abutment, and the other circular face against the

Fig. 1. In this illustration of double eccentric cam principle, *1'*, *1''* circular arcs, *2'*, *2''* centers of arcs *1' and 1''*; *3* actual center *2' 3* = *2'' 3* = *e'* eccentricity; *3'* pivot with center *3*; *4* swinging lever; *5* pivot for lever *4*; *6* base of fixture, *6'* abutment, *7* workpiece, *8* operating hand-lever rigidly connected to camplate *1*.



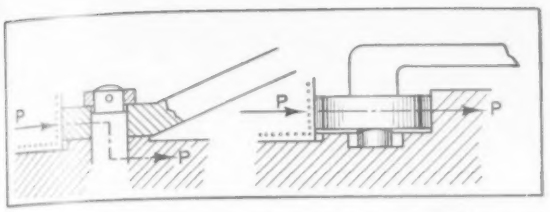


Fig. 2. Forces and stresses in an ordinary eccentric with bolt shown in A at left. B, at right shows forces and stresses in double eccentric without throughgoing bolt.

workpiece. If the workpiece to be clamped has just the nominal dimensions the lever will assume position III in which the center of the circular cam surface, the center of the cam plate and the pivot point are in line, preferably parallel to the face of the workpiece to be clamped. Ultimately position IV shows the clamping of a workpiece of under size.

Comparing the new double eccentric with an eccentric of conventional type for the same safety against unlocking, it was found that the eccentricity e' of the double eccentric (distance between the two centers of the cam faces $= 2\ e'$) could be 0.67 e, with the eccentricity e, i.e. distance of pivot center from center of cam face of the ordinary cam. However, the lift obtained would increase in the ratio $h'/h = 2\ e'/e = 1.33$ times with h' lift of the double eccentric, and h lift of the usual eccentric.

The weak points of the usual eccentric are avoided (Fig. 2 A and B), in the latter the bolt is highly stressed in shear and bending, the double eccentric cam plate is only under compression, all bending and shearing stresses are taken up by the fixture body. The frictional surfaces are easily controllable. After having explained the general principle, in the following some adaptions and applications will be discussed.

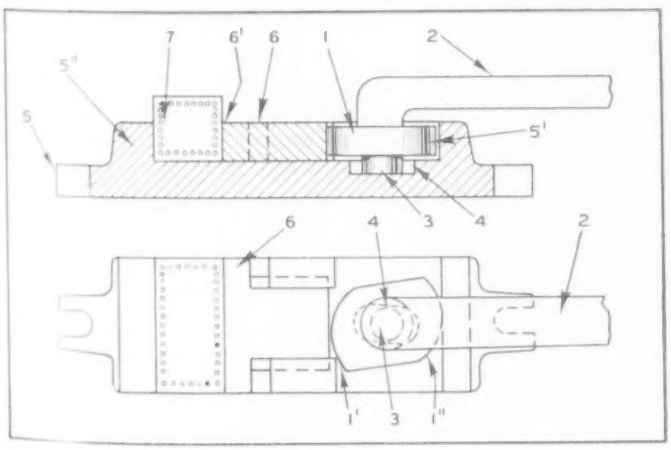
Fig. 3, shows the principle of a machine vise operated by the double eccentric cam lever. The cam plate composed of two circular but eccentric faces is connected by usual means, such as a square head fitting in a square hole. The cam plate has on its opposite side a central pivot, which slides in an elongated hole, in the direction of the long axis of the vise (replacing the swinging lever in Fig. 1). This insures a correct guiding of the cam plate preventing its escape in a direction perpendicular to the movement. One face of the cam abuts against a slide carrying the movable jaw; an opposite face of the base supports the fixed jaw and the workpiece is clamped between the jaws and for actual use it may be recommended to have a strong spring withdrawing slide from the workpiece to have a quick release action.

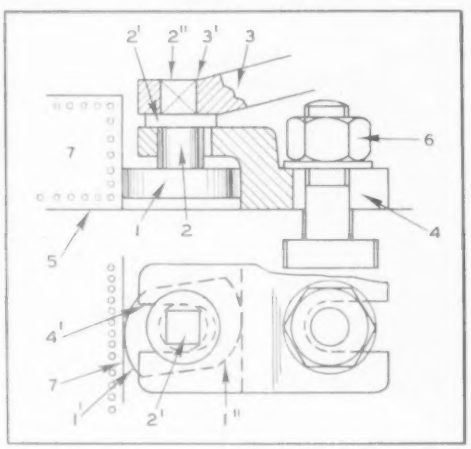
A further possibility is to make a self centering vise by fixing the center of the double eccentric and have one cam face acting against the movable jaw, as shown, whereas the other face (the left hand in the sketch) operates against a movable face connected with the opposite jaw.

Holding Larger Pieces

Fig. 4 shows a clamping device which clamps larger workpieces directly mounted on tables. The double eccentric clamp has a central pivot ending in a collar and a ,square head operated by lever with a square hole. The cam is suspended above the working table in a Z-shape block, fixed to the table by a T-slot screw and nut. The block has an open slot for taking the pin. The free face of the cam presses against the workpiece, placed on the machine table. Several of these clamping attachments can be used simultaneously on one or several workpieces. Fig. 5 is a further development of Fig. 4, whereby the workpiece is both clamped from the side and from the top by a bell crank lever. The suspension of the cam plate is the same as before, but the opposite side of the cam does not press against a fixed abutment, but against a bell crank lever suspended in a pivot and pressing the edge of the workpiece down. A special feature is

Fig. 3, at left, illustrates principle of machine vise operated by double eccentric cam lever; while a clamping device which clamps larger workpieces directly mounted on tables is explained in Fig. 4, right.





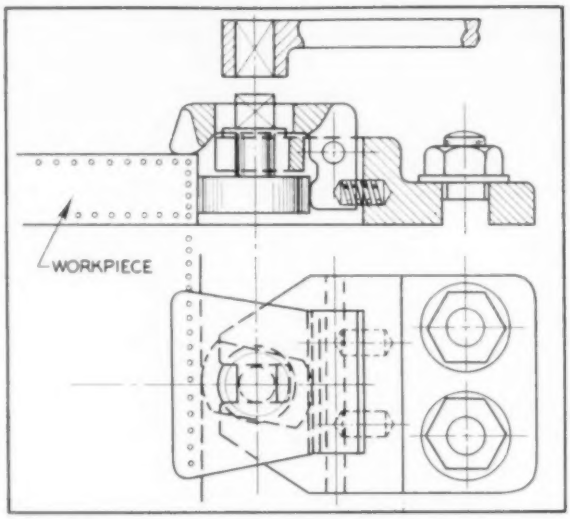


Fig. 5. Machine table clamping block is shown with both vertical and horizontal clamping.

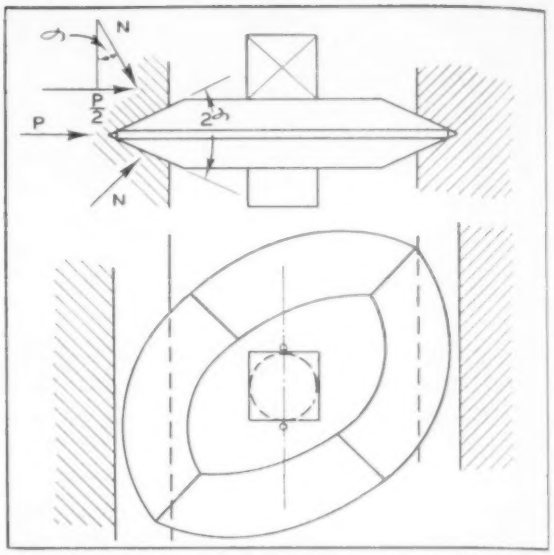


Fig. 6. Vee-shaped double eccentric can has increased lift and clamping power.

that the construction is relatively low. A special key is applied. A spring may facilitate the withdrawal.

Fig. 6 is a double eccentric cam, the faces of which are tapered. The force P is divided into two components N normal to the conical flanks, with $N = \frac{P}{2.\ \sin\ \alpha}$ wherein 2α included angle between the cam faces. The effected friction forces on the two opposite flanks are $F = 2\ \mu\ N$ with μ friction coefficient resulting in $F = \frac{\sin\ \alpha}{\mu} P$, whereas in the former case of the plain cylindrical cam: $F = \mu\ P'$ we obtain now a vee-friction coefficient $\mu' = \frac{\mu}{\sin\ \alpha}$. For instance with $\alpha = 22\frac{1}{2}$ we have $\mu' = 2.61\ \mu$; i.e. the friction force is increased about 2.5 times that of the flat cylindrical cam. When applying this principle it is therefore possible to increase the eccentricity and therefore the lift of such cams to about 2.5 fold that of flat cylindrical cams and to obtain an advantage of 2.5 x 1.33 = 3.2 times that of conventional cams.

In order to demonstrate the relative merits of either design a demonstration rig (Fig. 7) has been made which incorporates three different types of double eccentric cams; a device for measuring the compression force (test bar and dial gage) and a holder for an eccentric clamp of usual design. The bar of $\frac{3}{8}$ x $\frac{3}{8}$ cross-section and 4 in. between the supports deflects 0.001 in. under a pressure of 48 lb. When tightening the clamp E_2, deflections of 0.020 in. are usually obtained indicating a clamping pressure of 960 lb. Almost the same pressure was obtained when using the conventional eccentric E_1, demonstrating that the action is practically the same, however, the clamping range of clamp E_2 is larger.

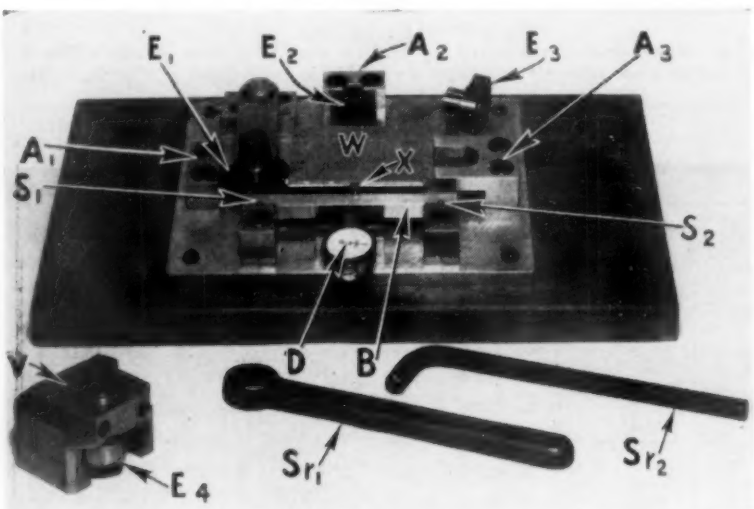


Fig. 7. A_1, A_2, A_3 are fixed to base plate for taking the back pressure of eccentric clamps. Double eccentric clamps E_1, E_2, E_3 (suspended on swinging lever, operated by square head; provided with cylindrical pivot below clamping head and sliding in slot at 4 and operated by square head; provided with cylindrical head, having hexagonal hole, respectively). E_4, conventional type eccentric with cylindrical bearing pin operated by square head, is mounted in block which can be placed over abutment A_3. B, bending bar, $\frac{3}{8}$ x $\frac{3}{8}$ in. mild steel; 4 in. between hardened steel pin supports S_1 and S_2. D marks small dial gage fixed to base plate, indicating bending deflection of bar under cam pressure. Sp_1 is spanner with square hole for eccentric E_1, E_2 and E_3 and Sp_2 is hexagon spanner for eccentric E_4. W marks the workpiece; X, the shield with center abutment for bar B, and V, the block to slide over abutment A_3.

Inspection by Optical Projection Methods

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Part I

ALL THE VARIOUS MAKES of contour projectors follow the same basic principle, wherein the outline or contour of the object being inspected is illuminated with a light source causing the object to cast a shadow. This shadow is magnified by a lens and projected on a screen where its magnified form can be examined visually. The schematic drawing shown in Fig. 1 illustrates the normal arrangement of these elements of light source, condensing lens, object, magnifying lens, mirror and screen.

Fig. 2 shows a magnified form of an object projected on a screen. By moving the object, an edge can be zeroed against a center line of the screen as shown at *A*. A micrometer is then zeroed, and by further movement of the part with the micrometer until another portion of the part is brought into exact coincidence with the same center line, as shown at *B*, an actual measurement can be made. When used in this manner, lens accuracy need not be an important factor. The magnified shadow is "zeroed" to a common point for taking the measurements. Present day comparators, however, are being used in a much different way. For parts inspection, rather than measuring by micrometers, there are lines on the chart and, to meet specifications, the shadow of the part must be coincident to both lines, as shown in Fig. 3. In order to be able to do this, one must be certain of the optical performance of the contour projector and that the rated magnification must be uniform over the entire screen area.

The Wilder micro-projector is a bench-type unit and generally does not have the measuring stage. It has a 14-in. screen diameter and the arrangement of the light source and lens have been changed to provide for vertical type projection.

The J & L pedestal comparator is a widely used instrument and has vertical and horizontal measuring features with a 14 in. screen area. Models include a bench-type machine with a 14 in. screen and a bench type with a much smaller screen. All of the models employ the same general arrangement of the optical elements.

The Bausch & Lomb contour measuring projector is used largely in gage laboratories. This unit uses a vertical light source and enables the operator to make measurements on flat pieces by placing them on a horizontal work stage. Measurement devices are convenient to use and the 18 in. diameter screen offers advantages. In order to change magnification it is necessary only to change the lens which can be done quickly. The image on this comparator is erect and unreversed at all magnifications.

One of the most recent developments in contour projectors is the one manufactured by the American Optical Co. As in the case of some of the others, this unit has the same general arrangement of optical elements, but has a 16 in. diameter screen. In order to change magnification, the lens must be changed, although mirror adjustments are not required. At some magnifications the image inverts and reverses and charts must be made to correspond with this condition. This unit does not have a measuring stage and is designed primarily for production inspection.

Another recent development in contour projectors is the Kodak, made by the Eastman Kodak Co. This unit is supplied with or without a base, and has a 14 in. diameter screen. By supplementing the usual arrangement of the basic optical elements, the versatility of the instrument has been greatly increased. The use of a relay lens system has contributed one of the most significant advances in that the clearance between the lens, which is the first obstruction, and workpiece is a full 8 in. distance, and this same focal distance is maintained without regard to magnification. This is particularly important when considering fixturing problems on some types of workpieces. The focal clearance permits the use

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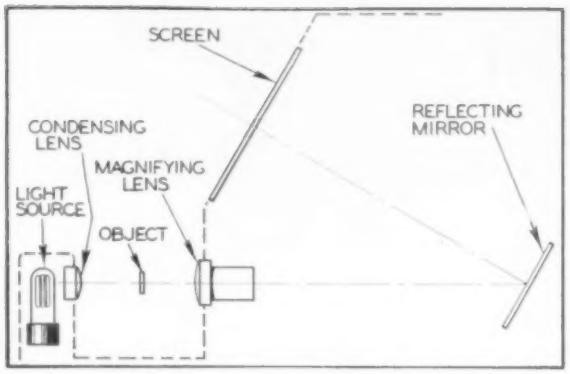


Fig. 1. Drawing shows usual arrangement of inspection elements—light source, condensing lens, object, magnifying lens, mirror and screen.

of the vertical lamp house and appropriate 45 deg mirror so that workpieces can also be staged in a horizontal plane.

By inserting an elliptical mirror in the relay lens system, light from a 1000-watt lamp is directed through the front relay lens, onto the object. The object reflects this light back into the lens, but since the reflected image converges, a hole is provided in the mirror through which the light forming this image passes. Another contribution is the fresnel lens located directly in back of the chart screen. It is a special optical element which increases screen brightness and, more important, permits the use of this unit in a normal lighted room without necessity of hoods or curtains.

Requirements of a Projector

For inspection by optical projection methods, the suitable contour projector should have the following basic features:

(1) Magnification of 10X, 20X, 31¼X, 50X and 62½X must be available to cover requirements.

(2) It must produce a shadow of the object on a screen at the rated magnification and, further, the magnification must be uniform at all parts of the screen, whether measured at the center or at the edges of the screen.

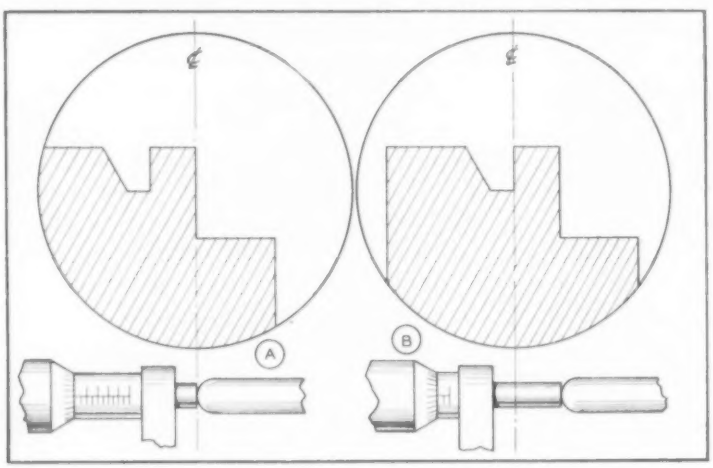
(3) The shadow outline should contrast strongly with the illuminated portions of the screen. Since shadow is opaque, the only way contrast can be assured is to have maximum screen brightness.

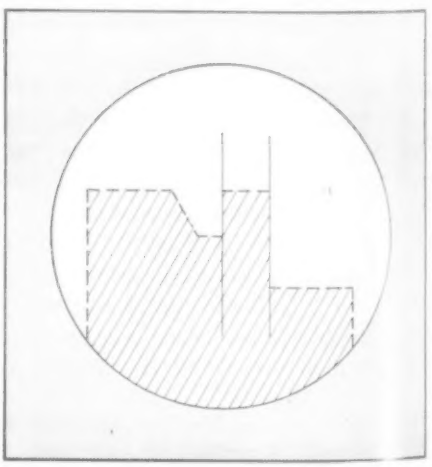
(4) There must be ample workspace free from obstructions, for fixturing.

(5) Arrangement of screen and all controls should be positioned for maximum efficiency with a minimum of operator fatigue.

Another important consideration in optical projection is the chart gage. The common methods of making these layouts are by the drafting board technique and by the scribing machine methods. For making layouts on the drafting board there are several different materials from all types of translucent paper to vellum-coated glass, and the type material selected depends largely on the type of inspection involved. Despite the unstable qualities of paper, it is satisfactory for inspection of some types of form tools and short run jobs. Plastic materials of all types are used and, as in the case of translucent paper, consideration must be given to the type of part to be inspected. There is dimensional unstability in both materials. However, in the newer type of plastics special considerations have been given to shrink and expansion characteristics, and consequently their use has been broadened. Layouts are made on vellum-coated glass. The bond of this vellum is exceptionally good and very many erasures can be made before the vellum is removed or rendered unusable. When using the vellum-coated glass, the greatest advantage is assurance of stability, but in addition, it has the same general appearance as that of ground glass although it is not quite as translucent. Another advantage is that

Fig. 2, left, shows projected object. As seen at *A*, an edge can be zeroed against a center line of the screen by moving the object; a micrometer is zeroed and by further movement of the part with the micrometer, to coincide exactly at the same centerline, as at *B*, actual measurement can be made. Fig. 3, right, shows today's comparator with lines on the chart to which, the shadow of the part must be coincident.





by a photographic process, it is possible to make a more permanent type of chart on ground glass from this master layout.

In laying out charts by the drafting room methods, the dimensional errors will be greater than if laid out by the toolroom methods using precision scribing instruments. The accuracy obtainable from drafting room methods of layout varies greatly with the individuals concerned. A certain amount of guess work is involved. For example, if it were required to lay out a 1 in. length using an engineers scale divided into 50 parts per inch, each sub-division of that scale would be 0.020 in. At best it is expected that a draftsman could sub-divide this smallest sub-division so that we could expect to read a scale within 0.010 in. When considering 10X magnification, it can be said that a layout could be made within the accuracy of 0.010/10 or 0.001 in. In other words, this is the error with reference to the component part. Since the layout error is divided by the magnification used, it is obvious that at the higher magnification, the component error is greatly reduced.

Layouts made by the scribing machine method are generally very accurate. In most cases, the scribing machine itself is considerably similar to a jig borer, having the *X-Y* compound table and, in addition, a rotary stage that is calibrated for angular movements. A "scribing" film-coated glass is secured to the table of the scribing machine and by using a rigidly mounted scribing tool of virtually any desired point width, lines are cut through the film, cleanly and perfectly transparent. The result is a scribed "negative" and from it, any quantity of transparency chart gages are made by a photographic process employing the "contact" principle. If changes need to be made, the original master scribing can be reprocessed by simply blocking out the original lines with film fluid and then rescribing to new specifications.

Improvement of Chart Lines

For many years the generally accepted type of chart line has been a single line of suitable width so that it will appear sharp and clear on the screen. The rule of thumb has been that the width of line is a function of the tolerance, that is, if the tolerance is broad, in order of 0.010 in. and 10X magnification is used, lines as wide as 0.010 in. can be used. In a way, this could be considered the same as a gage makers tolerance. On the other hand, if the tolerance on the component part is on the order of 0.002 in., a much finer line must be used. From experience, it has been determined that a line less than 0.003 in. wide is not practical from the inspector's standpoint. It is possible to produce finer lines; in the case of the etching process, the scribing machine method coupled with the subsequent photographic reproduction process has enabled the manufacture of lines of 0.0008 in. uniform width. Consequently, as inspection by optical projection methods has developed, it has become more and more necessary to devise chart lines that aid the operator to make a more rapid and accurate decision, and yet minimize eye fatigue. When component parts fall on or near the extreme limits, the question arises as to the proper interpretation of chart line and shadow coincidence.

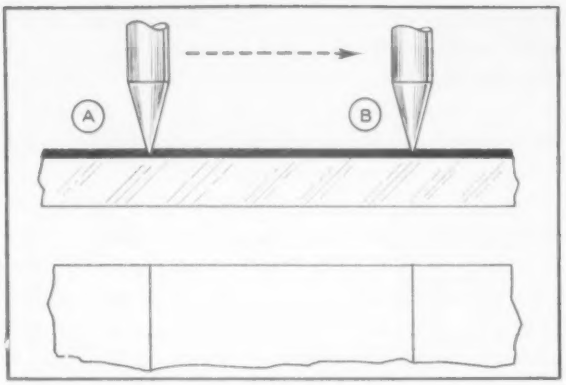


Fig. 4. Schematic shows laying out of two lines on chart by scribing machine technique.

In order to eliminate this "uncertainty" factor, new types of chart lines have been developed. Fig. 4 shows schematically the method of laying out two lines of a chart by the scribing machine technique. At *A*, the scribing tool is cutting through the emulsion and producing a very fine transparent line on the surface of the coated glass. By controlling the scribing tool point, this line can be of any desired width. Having scribed the line at the left, the scribing tool or the glass support table can be moved a distance of, say, 10 in. and a second line can be scribed. Any number of lines can be added to the chart by simply re-positioning the glass location with respect to the scribing tool location. The distance from the center of each line is 10 in. and, since the same tool was used in scribing both lines, the distance from the same relative sides of the two lines would also be 10 in. This method of chart line is the one used most frequently.

Fig. 5 shows a system of chart lines that is highly acceptable when measuring diameters of shafts, where the part is supported in the appropriate holding fixtures to establish the imaginary centerline. When scribing this type of chart, it is possible to use a scribing tool with a rather blunt point as shown at *A*. The distance from the imaginary centerline, established by the work-holding fixture, to the heavy broad lines shown to left, can represent the "no-go" limit of the diameter of the part. The distance from the imaginary centerline to the inside edge of the broad line shown at the right, would represent the "go" dimension of the part. For contrast reasons, these lines are purposely broadened and normally appear on the chart gage as a

dense black opaque line. When the shadow of the part is projected onto the chart screen, the only consideration for the operator is that there must be light appearing between the edge of the shadow of the part and the broad line shown at the right. If light appears between the part and the line shown at the left, the part is undersize. If no light appears between part and line at the right it would indicate that the part is oversize. The operator is never faced with indecision as to whether or not the shadow falls into proper coincidence, as may be the case with the single-line charts (Fig. 4). If a square is held against a flat surface, because of imperfection between the flat surface or the square, there appears to be a "sliver" of light between the two objects. If a bright light is placed in back of these two mating parts, it appears that the gap is indeed large, but when actual measurements are made the deviations are in the order of 0.0001 in.

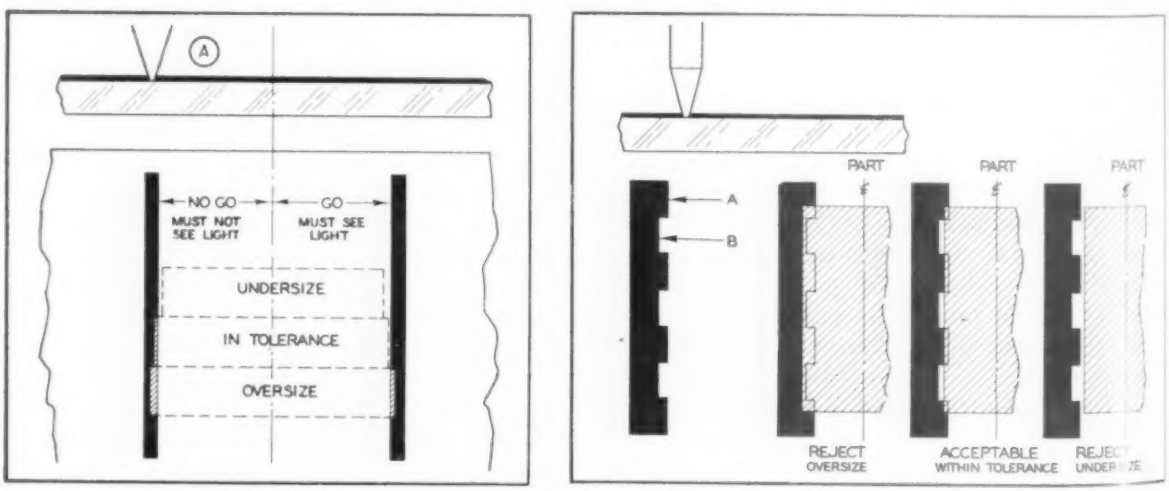
Facilitate Accuracy

The same general effect is experienced when using this type of chart. Using the same technique as that shown in Fig. 5, the bridge line shown in Fig. 6 can be produced with extreme accuracy, eliminating indecision and reducing operator fatigue. When scribing this chart, the distance from edge *A* to edge *B* represents the prescribed tolerance. For contrast reasons, the line has been widened to sufficient width to produce sharp definition between the shadow of the part and the chart line itself. When training an operator in the proper use of this chart, there needs to be only the understanding that the edge of the shadow of the part must form uniform rectangular openings of clear light. If the part is oversize, its shadow would completely fill the bridge opening and no light would escape between the chart line and the shadow of the part. If on the other hand, the part were undersize, light would escape between and maximum extremity of the shadow of the part and the so-called "footing" of the bridge, and consequently would produce an irregular pattern.

There are many advantages when using the bridge line. Of greatest importance is the fact that it is possible to check parts having a much smaller tolerance with very little eye strain. When using the bridge line, the "clear light" openings can be seen from a distance as much as 8 or 10 feet away from the chart screen. It would be impossible to do this with the conventional double-line system. Tests have shown that it was practical to use a bridge opening of 0.005 in. When this amount is divided by the magnification used, it actually represents the permissible tolerance on the component part. For example, at 10X magnification it would represent 0.0005 in. on the component part. However, this reasoning can not be used generally, since other considerations such as the type of comparator, screen brightness, and type of surface on the component part, must be taken into account.

Many other improvements have been made in engineering chart lines, all of them for minimizing fatigue, eliminating indecision and more generally to broaden the scope of this type of inspection. In recent months much consideration has been given to new development in chart lines for helping to expedite quality control inspection methods by permitting proper grading of the component parts with respect to the high and low limits of the permissible tolerance. Chart layouts are often made showing the basic form, with exceptions of certain portions of the part carefully and clearly indicated as being the critical portion, which must remain within specific tolerances. The mean line portion of chart gages of this type are used as guides in manufacturing operations.

Fig. 5, left. Diameters of shafts may be measured by system of chart lines. Shadow of part projected onto chart screen must overlap left scribed line, but not quite touch right scribed line. Fig. 6, right. Bridge line reduces indecision on inspector's part, yet insures extreme accuracy.



Steel-Spring-Type Vibration Mountings For Machine Tools

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Part II

Two important factors must be considered when analyzing a vibration problem: (1) the frequency of the disturbing vibration, and (2) the degree of vibration isolation required.

Disturbing Frequency: The disturbing frequency, f_d, is the number of times per second or minute that the vibration occurs. The most important frequency to consider is the lowest at which the corresponding magnitude is sufficient to cause trouble. If this frequency is isolated, any higher frequency vibration will also be isolated automatically, as will be seen from subsequent discussion. A safe rule is to consider the disturbing frequency equal to the rpm of the equipment causing the disturbance, since most equipment vibration is at rpm frequency. This applies particularly to the frequency of external vibration which may be disturbing precision machine tools. There are exceptions to this rule, as in the case of a milling machine where the vibration frequency is equal to the rpm of the spindle multiplied by the number of teeth on the cutter.

For slow-speed equipment operating below approximately 300 rpm, such as most punch presses, hammers and intermittent vibration such as caused by trucks and trains, it will be seen from subsequent discussion that very large spring deflections would be required to obtain true vibration isolation and to prevent transmitting the disturbing forces. However, by proper selection of the mountings, it is possible to obtain "Shock Absorption". True vibration isolation is not provided, since the disturbing forces are still transmitted, but the isolating material changes the sudden impact to a gradually applied force. This is the same principal utilized in gun recoil springs and similar mechanisms.

Although such vibration is of low frequency, it is often accompanied by high-frequency secondary vibration set-up by the initial impact. For example, a hammer blow sets up a tremendous initial impact which will invariably cause a deep surface mark on work performed on a nearby non-isolated grinder. This impact also sets the ground into violent vibration at its own natural frequency. Different soils have different frequencies ranging in general from 600 cycles per minute upward to several thousand. This secondary higher-frequency vibration is often carried through the soil with sufficient amplitude to cause a second series of closely spaced flaws on the work. The initial impact is the more difficult vibration to control, and mountings which will do this effectively will generally also prevent transmission of the higher-frequency secondary vibration.

Isolation Efficiency Required: The required isolation efficiency must be estimated at the time isolation mountings are selected. This efficiency depends upon the magnitude of the disturbing vibration, the strength of the supporting structure, and the type of work being performed. It is obvious that much more efficient mountings are required for use on weak floors than on rigid floors, and a higher isolation efficiency must be provided to protect a machine forming final precision operations than machines performing work which will be finished later on other machines. Experience has indicated that low-cost isolation materials such as cork, rubber, and felt, provide approximately 40 to 60 percent efficiency and are quite satisfactory from an efficiency standpoint on many installations. However, on critical installations springs are recommended because with them it is possible to obtain efficiencies of 98 percent and higher.

Vibration isolation depends upon the ratio of the frequency of the disturbing vibration, f_d, and the natural frequency of the isolation mountings, f_n. The isolation efficiency can be determined from the equation

$$\text{Percentage Efficiency} = 100\left[1 - \frac{1}{(f_d/f_n)^{2-1}}\right]$$

It can be seen that the efficiency increases as the

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ratio f_d/f_n increases. Since the disturbing frequency is generally fixed, the natural frequency of the mounting is made as low as necessary by increasing the deflection.

Natural frequency of isolation mountings: When isolation mountings are loaded, they deflect a definite amount depending upon the load and the resistance of the mounting. The deflection is given by the equation

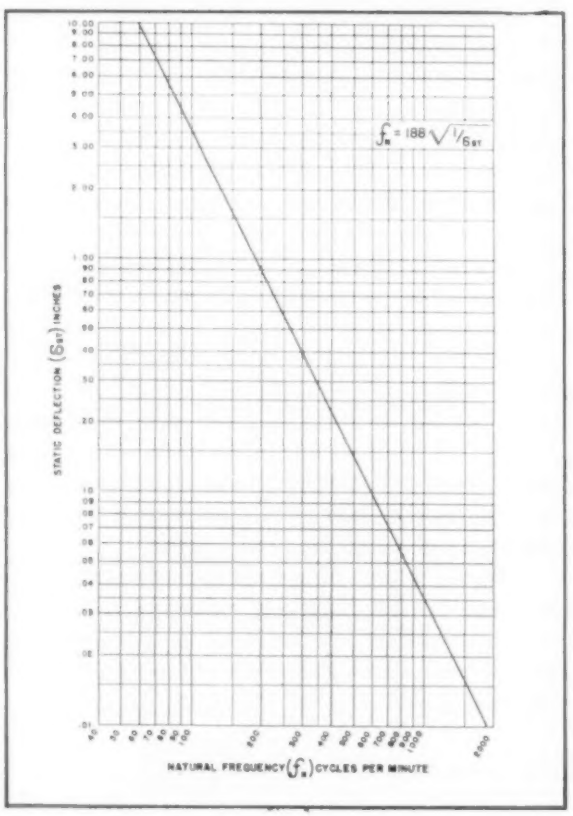
$$\text{deflection, } d = \frac{\text{Load}}{k}$$

where the spring constant, k, of the mounting is the number of pounds required to make the mounting deflect one inch. If a force is applied to a loaded mounting to give a slight additional displacement and is then released, the mounting will continue to oscillate at a definite frequency which depends upon the static deflection of the mounting (except cork and other materials with a great deal of damping). This is called the *natural frequency* of the mounting. For materials such as steel springs and rubber-in-shear mountings, the natural frequency can be determined from the equation

$$f_n = 188\frac{1}{d} \text{ in cycles per minute}$$

Fig. 3 is the graph of this equation. Note that it becomes increasingly difficult to reduce the natural

Fig. 3 shows relation between static deflection and natural frequency.



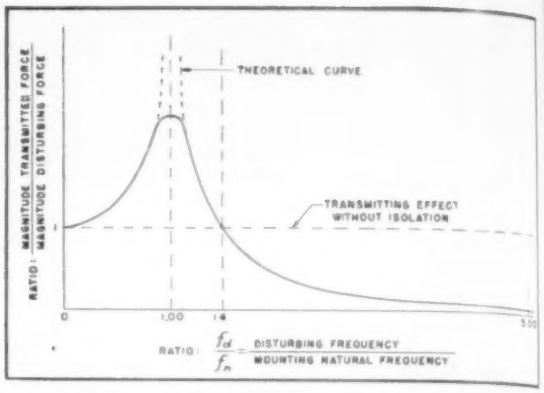

THEORETICAL CURVE
TRANSMITTING EFFECT WITHOUT ISOLATION
RATIO: MAGNITUDE TRANSMITTED FORCE / MAGNITUDE DISTURBING FORCE
1.00
1.4
RATIO: $\frac{f_d}{f_n}$ = DISTURBING FREQUENCY / MOUNTING NATURAL FREQUENCY

Fig. 4 pictures theoretical curve resulting from magnified forces produced by resonance.

frequency of a mounting because the required deflection increases much more rapidly than the natural frequency decreases. Not only vibration mountings, but all objects and structures have one or more natural frequencies at which they will vibrate when activated by an external force. For example, each piano wire vibrates at its natural frequency when struck, just as the soil vibrates at its natural frequency when activated by a hammer blow.

Resonance: When the frequency of the disturbing vibration equals the natural frequency of a structure or isolation mounting, the condition is known as *resonance*. At a near resonant conditions, even a slight disturbing force can produce tremendous effects because the force is magnified as shown in Fig. 4. Resonance frequently causes even slight vibrations of non-isolated equipment to be felt at great distances because the disturbing vibration happens to have the same frequency as the soil, building structure or distant object. A disturbing vibration having about the same frequency as the isolation mounting would result in excessive vibration transmission and movement of the isolated equipment: consequently, the natural frequency of the mounting must be carefully selected to prevent resonance during sustained operation of the isolated equipment.

Vibration problems can be solved directly without calculations through the use of Fig. 6 and Table I.

Calculating Vibration Requirements

(1) The lowest obtainable natural frequencies for different isolation materials are shown in Table I to aid in quickly selecting the required type of isolation.

(2) The horizontal axis of the graph is the disturbing frequency in cycles per minute. If the problem is to provide vibration isolation for a definite disturbing frequency, follow the vertical line corresponding to this frequency upward until

it intersects the oblique line corresponding to the efficiency desired.

(3) Opposite this intersection, read on the vertical axis the required mounting natural frequency. For steel spring and rubber-in-shear mountings, the corresponding static deflection will appear opposite the required natural frequency.

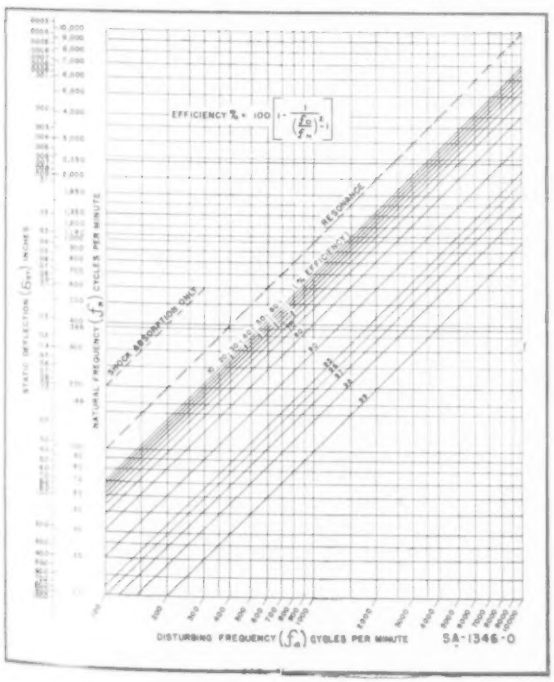
(4) Then refer to Table I to determine which type of mounting will provide the required frequency.

(5) The line *resonance* indicates the condition when the disturbing frequency and mounting natural frequency are equal. Sustained operation under this condition should never be attempted.

Example 1: Assume that it has been decided to install a precision grinder on vibration mountings to protect it from serious vibration generated by a large compressor creating a disturbance at its 700 rpm frequency. If the installation is critical and 90 percent isolation efficiency is desired, it can be seen from Fig. 6 that the natural frequency of the mounting must be approximately 200 cycles per minute, corresponding to a deflection of 0.8 in. It can be seen from the limiting values for different isolation materials in Table I that only steel spring isolators will provide this deflection. On the other hand, if the installation is not critical and 60 percent isolation would be satisfactory, the required natural frequency would be 386 cycles per minute, corresponding to 0.25 in. deflection. Some types of rubber-in-shear mountings will provide this much deflection.

Example 2: A punch press operating at 125 strokes per minute is causing a disturbance. Shock absorption is to be provided to change the shock to a gradually applied force. When providing only shock absorption, the natural frequency of the mounting is made higher, rather than lower, than the disturbing frequency. The minimum ratio should be approximately 2:1 in order to avoid any possibility of resonance. This means that the minimum frequency of the isolation mounting should be 25 cycles per minute. A steel spring isolator providing the spring deflection of approximately 0.55 in. under the weight of the press will have this natural frequency and will provide the highest efficiency. As stiffer mountings providing less deflection are used, the shock-absorbing efficiency of the mounting is reduced. For shock absorption of impact vibration, required deflections in the mountings should be selected above, but as close as possible to the oblique line marked "Shock Asorption" on Fig. 5.

Fig. 5 illustrates vibration absorption efficiencies for varying frequency ratios $\left(\frac{fd}{fn}\right)$.


EFFICIENCY % = 100 (1 − 1/(fd/fn)²)
RESONANCE
SHOCK ABSORPTION ONLY
NATURAL FREQUENCY (fn) CYCLES PER MINUTE
DISTURBING FREQUENCY (fd) CYCLES PER MINUTE
SA-1346-O

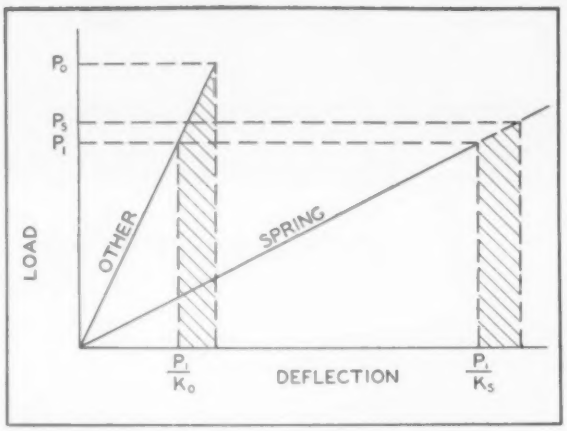


Fig. 6. Comparison of static deflections with applied loads. Equal cross-hatched areas indicate identical shock energy absorption.

Table I—Minimum Natural Frequencies for Different Isolation Materials

Material	Thickness, in.	Loading, psi.	Maximum Natural Frequencies*
Natural Cork	1	15	2350
Hair Felt	1	35	1980
Natural Cork	2	15	1650
Natural Cork	3	15	1350
Natural Cork	4	15	1200
S.A.E. F-11 Felt	1	35	1140
Rubber-in-Shear	¼ defl.	—	386
Steel Springs— Std. Stock Isolators	1¼ defl.	—	168
Steel Springs— Special designs	10 defl.	—	60

*Minimum natural frequencies, fn for different isolation materials under normal loads. Dynamic natural frequencies based on actual tests are given for cork and felt, since frequencies for these materials cannot be calculated and do not correspond to the static deflections. (If an isolation material packs and takes a permanent set, its dynamic natural frequency will increase). For convenience lines and values corresponding to the above frequencies have been drawn in on Fig. 6.

JIC Pneumatic Standards for Industrial Equipment (Continued)

A1.4—Legend Code

A1.4.1 Color Code

Function	Color
Intensified Pressure	Black
Supply Pressure	Red
Charging Pressure } Reduced Pressure }	Intermittent Red
Metered Flow	Yellow
Exhaust	Blue
Intake	Green
Inactive	Blank

A1.4.2 Pattern Code

Function	Pattern No.	Suggested Zip-A-Tone or Equivalent Pattern
Intensified Pressure	#7R	
Supply Pressure	#177	
Charging Pressure } Reduced Pressure }	#52-0	
Metered Flow	#63	
Exhaust	#75	
Intake	#16	
Inactive	Blank	

A1.4.3 Definition of Functions

Function	Description
Intensified Pressure	Pressure in excess of supply pressure and which is increased by a booster or intensifier.
Supply Pressure	Power Actuating air.
Charging Pressure	Compressor-Inlet pressure that is higher than atmospheric pressure.
Reduced Pressure	Auxiliary pressure which is lower than supply pressure.
Metered Flow	Controlled flow rate.
Exhaust	Return of power actuating medium to atmosphere.
Intake	Sub-Atmospheric pressure, usually on intake side of compressor.
Inactive	Air pressure which is within the circuit but which does not serve a functional purpose during the phase being represented.

A2.4.10 Pneumatic circuits shall be so designed as to prevent uncontrolled movement of the equipment-operating devices in all phases of the equipment cycle including the idling phase.

A2.4.11 Pneumatic circuits shall be so designed, and when necessary incorporate suitable dash-pot devices, as to adequately compensate for load variations and their effect on the compressible actuating medium in relation to the intended service.

A2.4.12 Circuits having two or more heads, slides or actuators shall be provided with means to insure all units operating in proper relation regardless of load variation.

A2.5—Enclosures and Compartments

A2.5.1 For the purpose of these Standards, an enclosure means a housing for pneumatic apparatus. A compartment means a space within the base, frame, or column of the equipment.

A2.5.2 Automatic controls that might be damaged by exposure to dirt or dust or stock moving equipment shall be adequately protected and readily accessible.

A2.5.4 Doors and other parts of compartments for automatic controls shall be sheet steel not less than 14 USS gage, or cast metal not less than ¼ in. thick. Compartments for automatic controls shall be completely isolated from coolant, cutting or lubricating oil, chips, and dirt.

A2.5.6 (a) When enclosures for control devices are required they shall have hinged covers which swing horizontally and shall be held closed with screws which require the use of a tool (wrench or screwdriver) to remove.
(b) Means shall be provided for locking when requested by purchaser.

A2.5.7 The arrangement of enclosures for mounting controls shall permit ample room for proper maintenance.

A2.6—Mounting

A2.6.1 (a) All Controls—All controls shall be mounted so as to minimize the possibility of damage from floor trucks or other stock moving equipment. They shall be protected against falling objects and operator's accidental movements. No controls shall be placed in high heat areas or in locations subject to any harmful conditions unless properly protected.
(b) Manual Controls—All manual controls shall be mounted within reach of the operator when in his normal operating position. Operator shall not be required to reach past revolving spindles or moving tools to reach manual controls. (See Paragraph A7.1.2)
(c) Automatic Controls—Automatic controls shall be so located and protected as to prevent inadvertent operation.

A2.6.2 All pneumatic controls shall be mounted two feet or more above the bottom of the equipment providing such mounting will not impair the proper functioning of the circuit. (This paragraph is written as a guide for all new machinery and equipment with the understanding that any deviation will be in accordance with Paragraph A0.2.)

A2.6.3 Pneumatic control units shall be mounted in positions which provide complete accessibility to all units for maintenance without interfering with adjacent equipment.

A2.6.5 All industrial equipment shall incorporate an emergency stop control readily accessible from operator's normal position.

A2.6.7 Piping shall not be used as a means for supporting valves or equipment where vibration may prove detrimental to piping.

A2.6.8 Automatic controls shall be mounted as close to actuator as practicable to keep working lines as short as possible to prevent waste of air and excessive actuating time lag. Mounting should be such that adherence to the above does not violate Paragraph A2.6.3.

A3—Compressors

A3.3—Mounting Compressors

A3.3.1 Compressors or subassemblies including the compressors, shall be readily accessible for maintenance.

A3.3.2 Compressors shall be mounted where they are adequately protected from damage.

A3.3.3 When compressors and other apparatus are mounted inside a compartment or enclosure, sufficient space must be provided to assure complete accessibility to all units.

A3.3.4 Compressor compartments must be clean, free of moisture and adequately vented. All openings must be of sufficient height above the floor or be protected to such an extent that dirt, chips, coolant, etc., cannot enter, especially at such times as floor is swept or washed.

A3.3.5 Direct-coupled compressors must be properly aligned and securely mounted in such a manner as to assure alignment under normal operating conditions. When mounted inside column or base

JIG Pneumatic Standards for Industrial Equipment (Continued)

of equipment, foot-mounted compressors and driving motors shall be mounted on a sub-base of adequate strength which can be easily removed for servicing. The coupling must have adequate capacity to transmit the power required.

A3.5—Compressor Nameplates

A3.5.1 The following information shall be permanently indicated on each compressor:
(a) Manufacturer's name and address.
(b) Manufacturer's identifying part number.
(c) Manufacturer's serial number if any.
A data sheet or catalog providing complete information on speed limits, pressure range, delivery and horsepower required shall be provided with the specifications.

A3.5.2 Whenever a compressor is mounted so that its nameplate is not readily visible, a plate with duplicate information shall be provided where it can be readily seen. Such duplicate plate shall be marked "duplicate". The nameplate shall not be removed from the compressor.

A3.5.3 The direction of rotation of each compressor shall be clearly indicated on the compressor where it can be readily seen.

A3.5.4 All necessary valves for removal of any compressor while other compressors are still in operation shall be provided.

A4—Piping, Fittings, and Passages

(Piping includes all pipe, tubing, hose and fittings. Passages include all air conductors other than piping.)

A4.1.1 When requested on purchase order, a piping layout or photograph shall be furnished.

A4.1.3 Piping shall have adequate strength to withstand additional pressure, including surge pressure, within the safety limits of the entire circuit. A factor of safety of a least eight (8) over normal working pressure is recommended except for flexible hose. (See Paragraph A4.2.4.)

A4.1.5 Piping leads in working circuits between actuating devices and feed control devices shall be so constructed as to rigidly confine a minimum volume of air, the purpose being to maintain constant, controlled motion and minimize the effect of varying forces.

A4.1.6 (a) Solderless pipe connections shall be used (for example: flared, flareless, self-flaring, flanged, or equivalent).
(b) When flared type fittings are used (which require a flaring tool), the angle of flare of tubing shall be 37 deg from the centerline, 74 deg included angle, and flare dimensions shall be in accord with Army-Navy Design 10061.
*(c) All pipe threads shall be Dryseal American (national) Standard Taper Pipe Threads (N.P.T.F.).
(d) Fittings with straight threads and which incorporate seals that seal with pressure may be used in place of pipe thread fittings.
(e) All piping connections shall be so designed and installed as to permit quick removal and reassembly by means of hand tools.
(f) Tubing outside diameter sizes shall increase 1/16 in. increments from 1/8 in. to and including 3/8 in., and in increments of 1/8 in. above 3/8 in. diameter up to and including 1 in. diameter and in 1/4 in. increments above 1 in. diameter.
(g) Fittings with restricted or stepped-up passages are not recommended.

*(See Engineering Developments).

A4.1.7 All piping, piping fittings, passages, storage or surge tanks, cored holes or drilled holes must be free of burrs, or foreign matter which might cause damage to any pneumatic unit. Sharp edges shall be removed whenever they adversely affect the flow of air.

A4.1.8 Whenever practicable, each piping run must be integral and continuous from one piece of apparatus to another. Piping runs must be removable without dismantling equipment components and without bending tubing or springing it in a manned to damage it. All rigid piping must be securely supported at frequent intervals to avoid vibration or movement. Points of contact or support on the outside of the piping shall be so designed that they will not result in damage to the piping. Piping shall not be welded to supports.

A4.1.9 When high or extra high pressure piping is used all connections shall be welded to steel flanges; or connections may be used which are equal in performance and ease of assembly. Flanged connections shall use sealing devices that seal with pressure (all welded joints shall be stress relieved).

A4.2.4 All portions of piping circuits subject to movements in which flexible hose is required, oil-resistant hose shall be used and shall be fabricated to a pressure safety factor of at least five (5) with respect to the circuit in which it is used. Flexible hose shall have vertical connections and shall have sufficient slack to avoid sharp flexing and straining. Horizontal connections are acceptable only if hose is adequately supported.

A4.2.6 Piping shall not be placed where it will interfere with the adjustment, repair or replacement of control units, and piping connections shall be readily accessible for maintenance.

A4.2.7 When construction of equipment necessitates shipment or moving in sections, thorough precautions shall be taken to adequately protect piping runs, whether they be left in place on one of the equipment sections or whether they are removed and separately boxed for shipment. All male threads shall be sleeved, and all piping openings or female threads equipped with suitable closures.

A4.2.8 Piping shall be so arranged that pressure may be tested at accessible locations, preferably at built-in checking stations which shall be indicated on diagrams.

A4.4—Identification of Piping and Checking Stations

A4.4.1 Piping runs and checking stations shall be permanently identified to correspond with diagram markings.

A6—Valves, Accessories, and Devices

A6.1—Filters and Lubricators

A6.1.1 Means shall be provided for the removal of deleterious materials from the pneumatic system which would be detrimental to the operation of the equipment.

A6.1.2 Suitable means of air line lubrication shall be provided when practicable.

A6.1.4 Filters shall be of such construction that the filter medium can be removed for cleaning or replacement without disturbing the piping. When practicable, suitable means shall be provided to indicate when filter should be cleaned.

A6.1.5 Intake cleaners shall be provided and shall be of ample size to clean more than double the capacity. Suitable means shall be provided to remove cleaners.

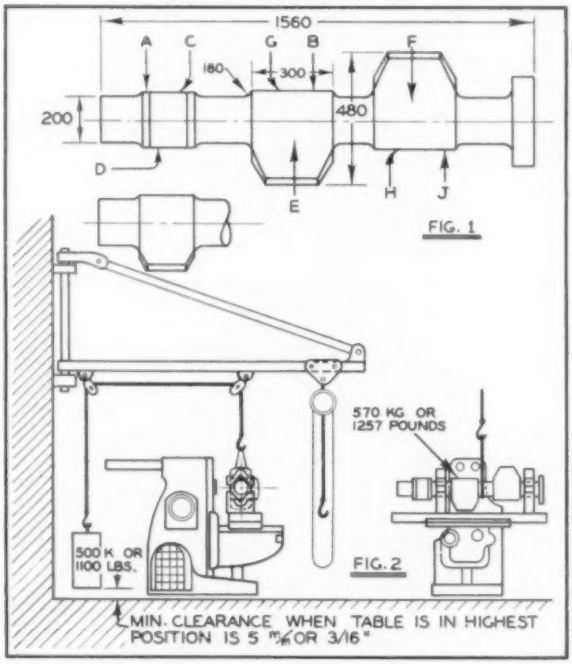
Gadgets

Ingenious Devices and Ideas to Help the Tool Engineer in His Daily Work

Improvisation Pays Off

Almost all shops have problems of improvisation when handling jobs too large or too cumbersome for existing equipment. In our plant, for example, we were required to mill the webs of large diesel engine crankshafts that, ordinarily, was done on a large horizontal boring and milling machine. But as the mill was tied up on equally important work, we decided to mill the webs on a Milwaukee 3K universal miller which, to put it mildly, was rather light for the 570 kg—1257 lbs.—of the workpiece.

Because the workpiece had to be shifted lengthwise on the table, resulting in undesirable overhang which, in turn, imposed inordinate strain on the table and knee, we cancelled out the weight with a counterweight suspended on a jib crane, as shown. The work was mounted on Vee-blocks and the swing of the crane permitted counterbalancing at any desired point.

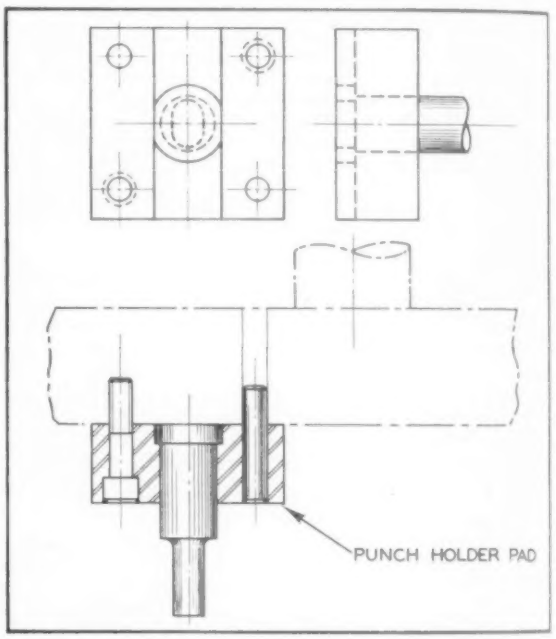


Counterbalancing a heavy workpiece, as shown, permitted milling in a smaller machine and with a marked saving in time over previous methods.

By referring to the workpiece drawing, it will be noted that we had to mill faces A through J, turning the part 90 and 180 deg for the several operations. Using a carbide-insert cutler, we took a cut ½ in. deep at a speed of 555 sfm and a feed of 9 in. per minute, completing the job in 6 hours, floor-to-floor time, as against 8 hours previously required for the boring mill. The conclusion is that if necessity is the mother of invention it may also effect marked economies as a result of new ways of making things.

L. M. Lepsoe
Bergen, Norway

Slotted Punch Holder



A slotted punch holder prevents irregular-shaped punches from turning while in operation.

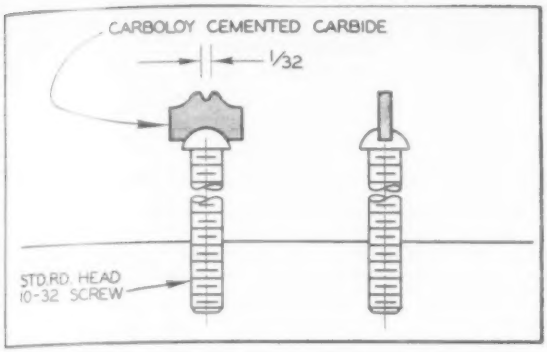
While there are many and varied ways to keep oblong, square, or other irregularly-shaped piercing punches from turning while in operation, the method illustrated is among the best. It is simple to make, easy to line up, and positive; in addition, removal of the punches for regrinding or replacement is greatly facilitated.

The punch holder pad has a slot milled all the way thru exactly the same depth as the thickness of the punch head. On the punch itself, flats are ground to fit snugly in the slot. Thus, it is virtually impossible for the punch to rotate even under heavy shock loads or undue stripping strain.

Irving Mansfield
New York, N. Y.

The Tool Engineer pays regular page rates for accepted contributions to these pages, with a minimum of $5.00 for each item.

Low-Cost End Mills



Small formed end mills can be quickly made by brazing Carboloy tips into the slots of screws and grinding them to shape.

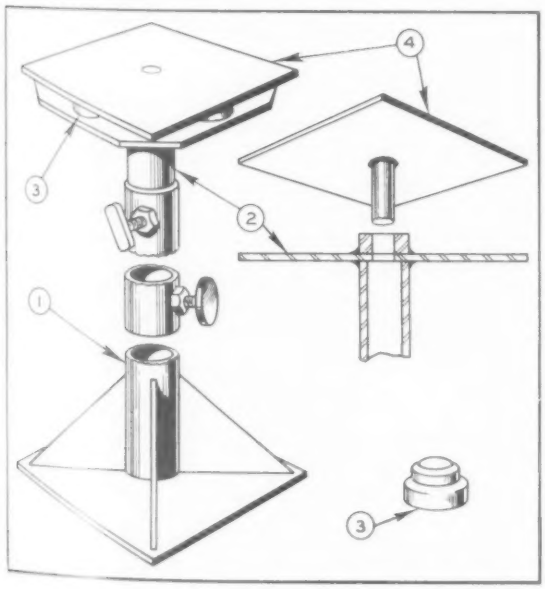
An ingenious and simple idea for producing small formed end mills was worked out recently in the Small and Medium Motor Divisions of the General Electric Company. The mills are made of standard Carboloy 883 blanks which are brazed into the slot in the head of 10-32 round head screw. The blanks are then ground to desired shape. The mills shown are used for machining oil grooves in sleeve bearings.

Contributed

Turntable for Plate

Occasionally, it is necessary to punch or drill around the periphery of heavy sheets or fabricated plate. In the case of unwieldy parts, this entails both effort and awkward handling on the part of the operator. Handling will be made easier by use of a turntable, such as illustrated.

An adjustable turntable, such as illustrated, facilitates handling and positioning of heavy sheets and fabricated plates when drilling or punching.



The base 1 is made up of a square plate, with gussets, to which is welded a length of 3 in. extra strong pipe. Two $\frac{3}{4}$ in. holes are drilled at 90 deg to each other, and about 6 in. apart lengthwise. Two $\frac{5}{8}$-11 nuts, welded on the pipe, in line with the drilled holes, serve as nuts for hand knobs.

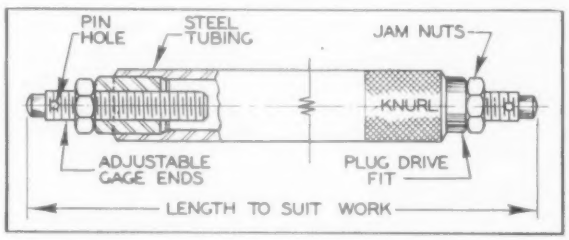
An intermediate plate, 2, comprises a square plate to which is welded a length of $2\frac{1}{2}$ in. pipe. The O.D. of this should slip into the $3\frac{1}{2}$ in. pipe with a slight clearance. To the plate, tack weld four ball transfers or casters, 3, as shown. To the center of the plate, weld a heavy washer whose thickness is slightly less than the height of the transfers. Drill a 1 in. hole in this washer.

In the top plate, 4, which should be somewhat larger than the intermediate, drill a 1 in. hole, insert a steel rod 1 in. in diam., and weld them together. When assembled, this plate will ride on the transfers, and the whole may be adjusted vertically by sliding the smaller pipe inside the larger. A length of loosely coiled spring inside the pipes would serve as a counterweight.

D. M. Kinniburgh
Chicago, Ill.

Tubular Bore Gages

While the many variations of "home made" inside gages all follow a general pattern, the actual construction may depend on material at hand. This could be especially true of shops in remote sections, such as ours. Lacking long inside micrometers, but having outside mikes, we made inside gages as illustrated.



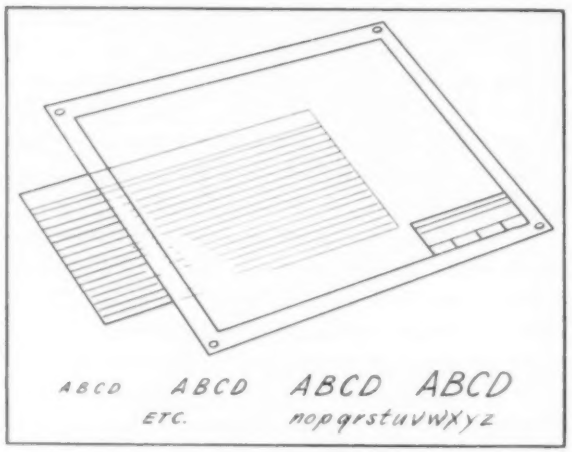
Inside bore gages such as illustrated are light in weight and have the advantage of considerable adjustment within a given range.

The body is of tubing, for lightness, and of a length to suit a range of bore sizes. The ends of the tubing are plugged and tapped, the holes chamfered, the ends squared true, and then case hardened. The gaging points are of threaded tool steel rod, ends radiused and lapped smooth after hardening. Two jam nuts complete the assembly. To use, it is only necessary to set the overall distance with outside micrometers.

Federico Strasser
Santiago de Chile

Simple Lettering Guide

Draftsmen who make their original drawings on transparent tracing or bond paper—as most of them do—can take a tip from the dime-store writing tablet which, placed under a drawing, provides excellent guide lines for lettering.

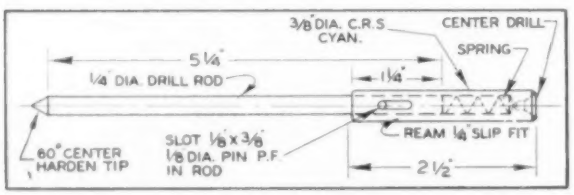


Ruled writing paper, or a "standard" with ruled lines, will provide handy guide lines for lettering when placed underneath tracing paper.

Users may find it advantageous to draw guide lines with different spacings, for different heights of letters. If these lines are inked, they will show more clearly through the tracing paper and will leave no faint pencil lines. The method is faster and neater than lettering between penciled lines, and there is no erasure.

Frank M. Butrick, Jr.
Chapter 38, ASTE

Lathe Center Indicator

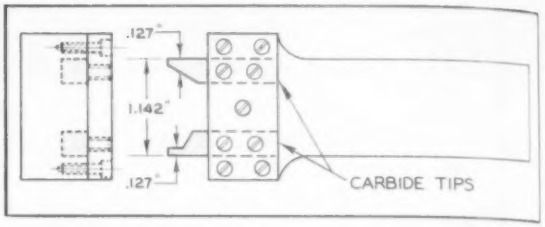


A spring-loaded centering device, for lathes, maintains tension between tailstock center and workpiece.

The spring-loaded lathe centering device shown is used with a dial indicator to locate or center work in a lathe face plate. The spring maintains proper tension between the lathe tailstock center and the workpiece, so that the latter can be moved or adjusted without injuring the center punch marks on its surface. It has been found to be a useful tool in the toolroom.

Wilbert E. Johnson
Forest Lake, Minn.

Versatile Tool Holder

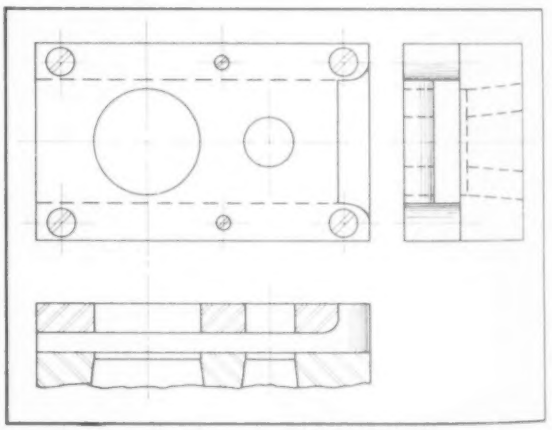


A simple grooving tool holder, applicable to a wide range of grooving operations, cuts grinding time and wheel wear.

A simple grooving tool holder, employing two carbide-tipped bits ground to the proper dimensions, has eliminated the tedious grinding of tools previously used in our plant and has affected savings in connection with silicon carbide and diamond grinding wheels in the maintenance of these tools. The dimensions shown are for a specific grooving operation in which one tool roughs the groove and the other finishes. Dimensions could vary to suit applications.

Henry Wisniewski
Allis Chalmers Mfg. Co.
Milwaukee, Wis.

Trouble-Free Die



Cutting away a portion of the stripper on a die, and rounding the edges, permits easy entry of strip.

Cutting away a stripper plate on a die, as shown, and putting a radius on the leading edge, permits an operator to start the strip into the die with a minimum of trouble. With the open entry, the die provides a ledge on which to lay the end of the strip, while the rounded edges of the stripper offers no sharp corners to abstruct entry. We have found this construction a time saver in our plant.

Frank L. Sloe
Springfield, Ill., Chapter

Smith & Wesson:

The Revolutionary Decade

By Gilbert P. Muir

THIS IS THE story of how a small company in a backward industry paralleled in ten years the century-old development of mass production methods which began in America after the Civil War. It is also the story of how an outstanding tool engineer, aided by a cooperative family management, brought new techniques to an industry which had not substantially changed its methods since the Civil War.

Smith & Wesson Co., in Springfield, Mass., has a reputation for making fine guns which goes back to the middle of the last century. Its revolvers played an important role in the famed taming of the West, and were a familiar sight on several continents. And, smacking of romance as it does, the simple fact is that in those days of pioneering the firearms industry reached its peak in marketing because men needed and were accustomed to using guns.

In the decades after Smith & Wesson's introduction of the first firearm using self-contained metallic cartridges in 1856, further developments in powder making, cartridge and revolver design resulted in a better product. Progressively, handguns developed greater velocity and better accuracy.

But simultaneous with this came three important factors: the civilization of former frontier areas, which also led into the second, restrictive laws on the sale and use of firearms, and the subsidization by foreign governments of arms industries in their own countries.

Then a situation arose in this important industry which is almost the reverse of normal industry development as we know it. Smith & Wesson, which was typical of the firearms industry, found itself working on new developments to create a better product which at the same time its market was uncontrollably shrinking geographically and financially.

From Gunsmith to Gun Maker

The founding of such companies as Smith & Wesson in the nineteenth century represented a second stage in development of manufacturing methods in this industry.

The first—and this is little more than one hundred years ago—was the individual craftsman, turning out a few guns on a strictly custom basis. Smith & Wesson represents the original jump toward mass production: the gathering of these gunsmiths into a factory.

Arms production at the Smith & Wesson plant in the nineteenth century was on a level well in advance of average industrial production at that time. Not only were workers master craftsmen, but they were accustomed to working on a precision product with fits and tolerances which were remarkable, considering the period. As a matter of fact, when parts tolerances were reviewed during the past decade it was found that some of the early standards were, if anything, more precise than necessary—this in a day when there were no dial indicators or comparators.

Thus in its golden period we have a company far in advance of American industry in production techniques, and which had succeeded in "mass producing" a formerly handcrafted product. There was, also, a heavy investment in machinery.

Then the receding market, which of necessity forced the entire industry to become conservative, to think of entrenchment rather than expansion. Where new mass production industries were working hard at finding new ways to produce faster and keep up with an expanding market, the firearms industry faced a double dilemma. On one hand was the rising cost of manufacturing: higher wages, higher machinery cost, increased taxes and all the other manifestations. On the other hand was the inescapable fact that a declining market was not, in their conservative minds, a good basis on which to undertake modernization of facilities. Obviously, as replacement is delayed from year to year, production becomes more and more inadequate by today's standards.

A major blow hit the industry in the form of the depression of the 30's, and by the approach of World War II a once-proud company was heading for the financial rocks.

The First Step Forward

Carl R. Hellstom, a topnotch production man and a conversationalist

Operations on Stockbridge St. . . .

about whom it is easy to slip into superlatives, entered the Smith & Wesson story in 1941. The company's operations had reached the critical point partly because lack of a continuous modernization program had finally resulted in a situation where the obvious answer was a complete production overhaul. The other factor was an immediate demand for great quantities of guns for war—a demand to which the company was not in a position to respond because production had been keyed to the normal (and shrinking) peacetime market.

Hellstrom, when he joined S & W as plant superintendent in 1941, had been recognized as a top production man since World War I days. An ordnance head during WWI, he became president of the American Rack Co. in 1922 at twenty-seven, and in 1928 left to become a consulting engineer. As a consultant, he had been retained by Smith & Wesson during the thirties and this, coupled with his reputation, made him a logical choice when the Wessons made the decision to attempt conversion of a craft industry.

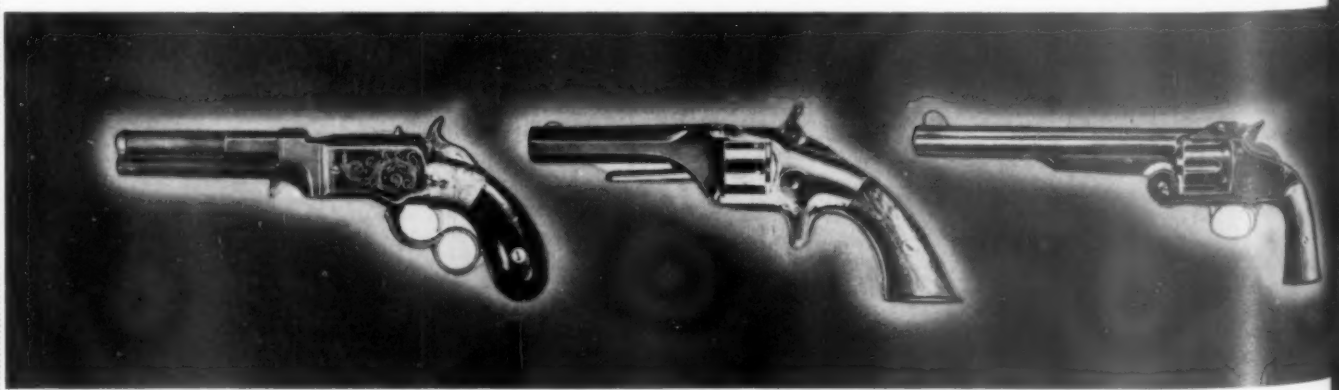
To bring a feudal industry to a mass production basis within a short time is, under ideal conditions, a really tough assignment. But the conditions at S & W were far from ideal. There was neither the cash nor the permanent market to even consider retooling the plant completely for fast, low-cost production. This meant that, in most cases, existing machinery—the majority of it 70 to 80 years old—had to be used, while at the same time reducing costs, introducing new methods, and increasing production at least tenfold.

As Hellstrom points out, it is one thing to draw plans for retooling a plant completely, another thing to attempt to fit in new machines alongside equipment which dated literally to Civil War days. He illustrates the point with an incident which occurred after he had been at S & W about three or four days.

Hellstrom, in walking through the plant, began to watch eight parts operations being performed on separate machines; machines which haven't been in general use for perhaps the last 70 years. So he talked to the master mechanic and two of them, working all night, came up with a design which would combine all eight operations on one machine.

However the department foreman, when shown the design the next day, threw the explosive Hellstrom into a furor when he studied the design and observed that it wouldn't work into the line. The machine would perform all the functions it was designed for and, on its own, would work. But the old single-operation machines used a specific locating point part-way up the line, then switched to another. Adoption of the new design meant retooling from that operation to the end of the line.

Left to right: the Volcanic, introduced in 1854. The repeating action was the forefather of modern lever-action rifles. The .22 rimfire was the first successful revolver to use self-contained ammunition. Well-known on the frontier was the .44 American, introduced in 1869.



TOOL ENGINEERING IN *Action*

Retooling Without Tools

Mass production involved people as well as machines, and the firearms industry by its nature had grown up with practices completely opposite to those in large industries. For example, when Hellstrom refers to the old arms industry as a virtual feudal system, he means just that. Around the turn of the century at Smith & Wesson, there were 26 departments in the plant, and each department was a separate entity negotiating with management on a contractual basis for the production of parts from its department.

By 1941 this system had, of course, been out of existence for many years, but the old feelings about separate kingdoms had continued. Hellstrom and Dan Wesson point out that instead of interdepartmental cooperation or understanding of common problems, foremen knew nothing of the departments beyond their own, and in some cases wouldn't even go into another department.

All this was a hangover from craft manufacturing, and Hellstrom's reaction was to organize a foremen training school to bring problems out into the open and promote mutual discussion. The same type of effort was directed to methods within the company such as accounting and inventory control—methods which, like the machinery in the plant, had lain dormant for many years.

One good answer to the delicate financial status of S & W, discussed previously, was a substantial increase in production now that the demand was present. And one deterrent to increased production was the model system of manufacture, used historically in gunmaking.

. . . Contrast with S & W's new plant

Continued through the years, the technique of getting a revolver into production consisted of making a precise model of the desired gun, and then merely making further duplicates of that model. Machines were set up, tolerances as such and locating points were established from that model. Naturally with handling, the model wears down, and tolerances change accordingly. Again, since the emphasis was on increasing production, it was impossible to wait until existing models and dimensions could be transferred to parts drawings, so both had to go forward concurrently. Through the war—and the work is still going on—tolerances were established on the basis of existing practice; details of parts were recorded on drawings and future production was then on the basis of the new drawings. As Dan Wesson points out, it is engineering in reverse; going back to the existing product to find out how it was actually being done, recording that, and then reviewing these findings to see if existing practice can be improved.

Another factor in establishing standards and tolerances was that for several decades Smith & Wesson workers were using special S & W standards entirely apart from any

A great military arm and target revolver was this 1870 model .44 Russian. The .38 double action at center dates to 1877; was a favorite of Western sheriffs. S & W's famous hammerless, conceived by founder D. B. Wesson as a truly safe revolver, (right) was developed in 1888.

Finished guns and ammunition for testing are stored in this underground vault until shipped.

others. For example, the S & W half-inch actually measured 0.508 in. The S & W inch was 1.0034 in. There was a special S & W taper, as well as an S & W form thread—all just a little off standard.

As was true with other problems, making guns from models originally had an excellent *raison d'etre*. During the last century, when accurate measuring instruments were not available, it was the practical way to insure a precision product. The weakness of the system was forcibly pointed out in World War II when, with one model to work from, only one fixture could be employed, and production was seriously curtailed until conversion to parts drawings was completed.

Machines

Back during the last century when the majority of Smith & Wesson's machines were new, machines were cheap and labor rates were considerably less than they are today. Single-purpose machines were the rule, of course, and the two factors just mentioned made them economically justifiable at the time.

During the late thirties, when S & W had the depression behind it and began to look at the machine situation, wages were approaching the wartime level and single-purpose machines had become a substantial reason for high production costs. At the same time the tempting advantages of multi-operation machine tools had to be reconciled with sales and available funds.

Since machines were cheap in the old days, it was the practice of S & W to maintain a completely set-up and fully tooled line of machines for each gun model, then shift workers from one line to another as demand shifted from model to model. With modern machine tools one can't do that, and production was changed over as far as possible to a lot manufacturing plan, whereby an inventory is built up on a given model and then all set-ups and tooling are changed to another model revolver.

At the beginning of Smith & Wesson's evolution to modern practice there were about 80 old-type power milling machines in the small parts department; all of these, as pointed out, single-purpose machines. As new machines were fitted into the operation, the potential replacement ratio (old machines required to equal output of new machines) was found to be as high as ten to one.

However, new tooling and a reasonable increase in feed rates helped get more production. Previous feed rates on the old milling machines, for example, averaged 1.5 to 3 ipm—mostly around 1.5. With new HSS cutters climb milling was jumped to eight to 18 imp, and gang milling with 25 pieces to a fixture replaced the old two-pieces-in-a-vise practice.

There is a limit to increasing speed rates on the old machines, of course. These machines were built for low-carbon steel tools at slow speeds, and while better tooling can raise output several hundred per cent, there isn't the "beef" or the horsepower to equal today's equipment.

Tools Past and Present

One place where a lot of changes could be, and were made immediately was Smith & Wesson's tool setup—design, manufacture, maintenance and storage.

First off, Hellstrom learned that not only was there no tool catalog, but that in addition there were only a couple of old workers who even knew the location of the tools in the crib. He illustrates this with a

Single-shot .22 target revolver at left was introduced in 1891, is still a favorite. Over 3,000,000 of the 1902 Military and Police (center) have been made. The .45 Army at right incorporates S & W's half-moon clip which makes it possible to use regular .45 automatic cartridge.

story: "I was up in the plant one day, and we were looking for a certain cutter. So the foreman sent a man up to the small tools department, who came back with the report that there was no such cutter—all the tools had names; there were no tool numbers or catalogs. The foreman hit the ceiling and said, 'I know damned well—I remember back in 1905 that they made this cutter and I used it.' So off he trotted to the small tools department.

"Well, I was a little curious to see how this thing would come out, so I trotted along behind him. He came up, and 'Walter,' he said, 'what the hell do you mean by telling me we don't have an X-X cutter?' Walter replied, 'Oh, sure, I thought he meant a Z-Z cutter'. With that he walked into the toolroom, pulled out a drawer halfway to the ceiling, took out two or three compartments, and handed over the tool.

"So I asked him, 'Now look, how did you find that so quickly. Got a tool catalog or tool numbers'? 'No,' he said, 'I don't need any guideposts'—'I've been here for forty years and I know where every one of these tools is.' At which point Hellstrom asked the much-quoted and reasonable question, "Fine, but what happens if you drop dead tomorrow?"

Under Hellstrom's direction, Dan Wesson began the cataloging, which became the basic guide of tool redesign and standardization. Without a central record, slight variations of tools had quietly grown into the status of standard tools, and rarely, of course, was a design dropped.

Patient study of tool redesigning was geared to the machines S & W had to work with. Dan Wesson recalls one old cutter having thirty teeth, which he felt could turn out considerably more work with about one-third that number. In some cases, such as this one, the old machines could not take the extra load, and a halfway compromise had to be found.

Tool design quickly became a two-way proposition, furthermore. As new machines could be found (this was wartime) and fitted into the line, it was apparent that existing tools were as unsuitable as modern tools were for the old machines. Fixtures as well had to be changed, since with bigger machines, higher horsepower and heavier cuts fixture breakage became a consideration.

Individual tool grinding also gave way, after a time, to a central toolroom operation. Through the years there had been master craftsmen running S & W's machines, and each of them took great pride in his ability, including the grinding of his own tools. As a result there were as many ideas and variations on angles, etc., as there were machinists and setup men. Since the practice had developed some good grinders, S & W picked the best of them and set them up in a cutter grinding department,

S & W revolvers are tested on the firing range for accuracy and firing characteristics.

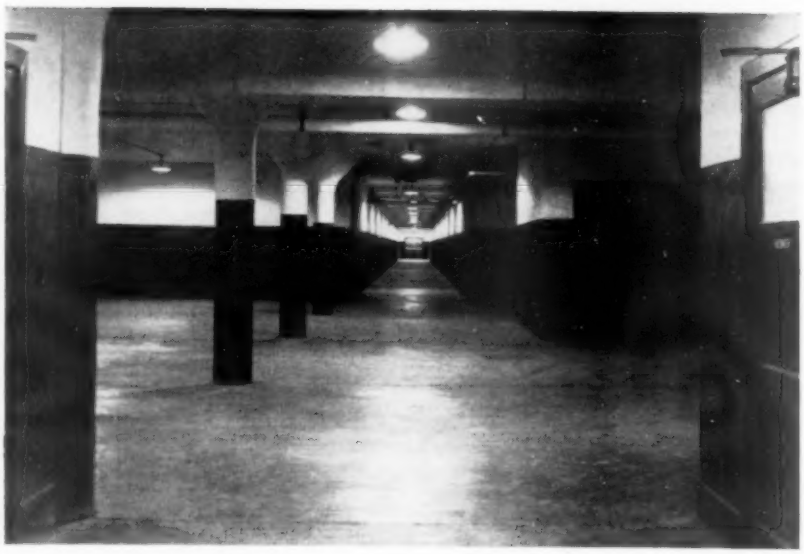
which became a part of the central toolroom.

The Crumbling Bricks

Perhaps the major concern of Carl Hellstrom, shortly after taking over operations of the company, was getting operations out of the obsolete, high-cost, inefficient Smith & Wesson plant in downtown Springfield. Built in 1863, the plant had long outlived its usefulness and was a production liability.

Hellstrom estimates that, in the course of manufacture, some parts traveled as much as twenty miles up and down stairs and along machine lines in the old four-story buildings. In addition, new drop forge facilities were a vital necessity, since under

S & W's .357 Magnum, left, is said to be the world's most powerful sidearm, delivering 1510 ft-sec muzzle velocity. K-22 Masterpiece, center, is a popular target model. "Victory" model, right, was made by S & W in tremendous quantities during World War II.



View through one of S & W's subterranean passages. Trucks may enter lower levels of plant via ramps, then are routed to various sections through passages of this type.

wartime three-shift operation the hammers were literally shaking the walls apart. There was even a further consideration here in that the plant was about two blocks from Springfield's city hall, and was built on a hard clay strata running down to glacial rock. The clay served as an excellent transmitter for the vibrations of the drop hammers, and Hellstrom recalls that he could stand on Main Street, two blocks away, and feel the vibrations of the hammers.

Building a new plant was a repetition of the old problem. There was no money available to construct a plant (S & W had been drastically reducing its debt), but neither could the company operate profitably in the old plant.

The story of Hellstrom's struggle bears repeating. It started with a swamp site on the edge of Springfield, where the company had one lot, and where Hellstrom felt would make an ideal site. In subsequent negotiations he managed to acquire enough additional swamp land to total 126 acres, at a cost of $29,800. Then began the four-year battle to build the plant out of earnings.

Hellstrom's first concern was to get the drop forge department out there, so the site was drained, graded and in places filled in with sand. The drop forge plant went up during the war as the first building in his overall plan, and as materials and funds became available more and more operations were transferred to the new plant, which was completed in 1948.

Smith & Wesson's new suburban plant rightly is a point of pride. Besides representing a major milestone in their ten-year advance toward modern methods, it offers a combination of efficient peacetime production plus maximum wartime security.

Hellstrom, in designing the plant, aimed for a plant that would offer this combination without excessive construction cost. His widely-spaced buildings, construction features and potential underground manufacturing space have supplied this. Firstly, since the fill under the plant rests on the swamp, and the foundations are supported on pilings, the force of explosions or bomb hits is dissipated through the ground.

Hellstrom managed to incorporate his highly resistant underground area without adding greatly to the price. Roofed by heavy reinforced concrete ceilings, this area is now used primarily for storage, but within a few months, in case of war, machines could be moved down there for safer manufacturing. Where possible, facilities have been duplicated, including a natural-draft ventilation which works independently of the plant heating system and which would minimize danger of spreading poisonous fumes through the plant. Other features, such as transformers dispersed through the plant; dust collectors and elevator motors removed from the roof; valves and mains recessed into walls will minimize dangers from aerial strafing attacks or internal explosions in corridors. In addition, spread-out design of the 300,000 sq-ft plant, with wide, open courts makes it harder to knock out the plant in a single bomber run.

The Results

How well has Smith & Wesson succeeded in trying to cram a hundred years of manufacturing progress into a ten-year period? Production figures offer one indication: gun production which hovered around 140-150 per day in 1940 reached a peak during the war of 1150 guns per day, mostly through improved tooling and methods, and without the opportunity to add many new machines. Costs were reduced to the point where S & W, which had always been undersold by its chief competitor by about two dollars, finished the war underselling the competitor by eight dollars. Almost $1.5 million in debt was paid off during this period; the new plant was built and paid for out of earnings; and the company's stock took a jump of several thousand per cent.

A considerable amount of old machinery is still awaiting replacement under S & W's gradual modernization system, but the system is well-balanced between the present cost picture on one hand and desirable costs determined by the market potential on the other hand. Smith & Wesson will never be an exhibit of transfer machines, but it has throughly demonstrated what tool engineering techniques can do in a small, backward industry.

Society Nears 100-Chapter Mark With Oklahoma, Ontario Charterings

More Than 175 Tulsa, London-St. Thomas Members Found New Tool Engineer Groups

Above, left: Tulsa officers receive the new chapter's charter from J. J. Demuth, Society president. From left: D. H. Roberts, secretary; C. T. Beeson, first vice-chairman; Mr. Demuth, Louis Trainor, chairman; J. M. Krisman, second vice-chairman, and A. I. Zumwalt, treasurer.

Right: L. B. Bellamy, first vice-president, swears in charter officers of London-St. Thomas and District chapter: Albert H. Ward, chairman; Louis Jensen, first vice-chairman; W. H. Brannan, second vice-chairman; W. G. Lyon, third vice-chairman; Alfred Trueman, treasurer, and T. L. Pherigo, secretary. Vice-President T. J. Donovan, Jr. listens to ceremony.

THIRTY-ONE of the 48 states in the Union now have ASTE cities. And one Canadian province is home of six Tool Engineer groups. These marks were reached in June with the founding of two chapters half a continent apart.

Oklahoma was added to the chapter roster when 67 tool engineers were chartered at Tulsa, June 12. This 90th chapter was ushered in at a dinner meeting in a restaurant operated by Spartan Aircraft Co. in connection with its production facilities and flying school. An attendance of approximately 75 included visiting Society officers and local guests.

Trainor Elected Chairman

As the result of an election conducted by Executive Secretary Harry E. Conrad of Detroit, Louis H. Trainor, assistant general foreman, American Airlines, Inc., was named chairman. Other officers elected are: First vice-chairman C. T. Beeson, engineering manager, Spartan Aircraft Co.; second vice-chairman, J. M. Krisman, president and tool engineer, Krisman Industrial Supply Co.; secretary, Donald H. Roberts, chief of production, USAF Air Material Command, and treasurer, A. I. Zumwalt, machine shop foreman, Service Pipe Line Co.

President J. J. Demuth of St. Louis swore in the new officers and Director-Elect H. E. Collins of Houston presented a chairman pin to Mr. Trainor.

In a brief talk President Demuth impressed the engineers with the importance of the Society's activities and services.

Assurance of cooperation from the Tulsa Chamber of Commerce was given in a welcoming address by a Mr. White, who heads the industrial division.

Clark Sends Congratulations

John C. Newton of the Unit Rig and Equipment Co., prime organizer of the group, read a telegram from National Membership Chairman A. B. Clark of Cleveland, extending congratulations and best wishes.

Besides the officers and Mr. Newton those affiliated with the Tulsa chapter are: Raymond H. Blackwood, James A. Breedlove, and Clair M. Regur, U. S. Air Force; William J. Blank and Cecil E. Gordon, Industrial Equipment Co.; John W. Brandle, Thomas S. Moughon, Kenneth Wallingford, and Herbert F. Wilson, Unit Rig and Equipment Co.; Clifford K. Brewer, Manning, Maxwell & Moore.

Charles E. Carter, Jack Meydag, Kurt Ruger, Orville O. Sager, David Wark, Sidney W. Ford, Clarence E. Gahm, Donald F. Froelich, Virgil E. Morse, Peter Reis, Phillip Saint Erne, and Henry Tedeschi, American Airlines; Lewis A. Clark, Marvin R. Gilstrap, A. H. Hawkins, L. S. Kizer, and Joseph B. Roberts, Orbit Valve Co.

Samuel A. Collier and Boyd L. Hickok, Franks Mfg. Co.; George A. Cramer, National Twist Drill & Tool Co., Oklahoma City; Theodore N. Duncan and Frank W. Rosicka, Tulsa Winch Div., Vickers, Inc.; Frank W. Fowler, Gasco Pump & Burner Mfg. Co.; C. E. Gildersleeve and Herbert S. Lee, Douglas Aircraft Co.; Samuel D. Hawkins, H. K. Porter Co.; Clyde J. Hunt and William B. McDermott, Precision Tool Sales.

* * *

Ovel C. Jones, Hinderliter Tool Co.; Robert E. Kenngott, White Star Machine & Supply Co.; Robert M. Logsdon and Otis T. Smallwood, Interstate Tool & Mfg. Co.; Marion D. McGinnis, Macnick Div., Ohmer Corp.; Howard C. Miles, Robert K. Scheer, and Harold

William Hutcheson (left), London-St. Thomas membership chairman, receives the first of the National Membership Committee's new kits from H. E. Conrad, executive secretary.

C. Lowe, Crescent Machine Co.; Thomas L. Price, Holo-Krome Screw Corp.; Lester W. Williams, Ajax Die Casting & Mfg. Co.

George R. Hannefield and Joseph E. Morrow, Walter O'Bannon Co.; John H. Keyes, Dempsey Pump Co.; James T. Lynch, J. T. Lynch Co.; Joseph W. Snyder, Marshall Supply & Equipment Co., and Lyle A. Foland, Parkersburg Rig & Reel Co., Coffeyville, Kansas.

John R. Greech, Leslie W. Ferguson, John A. Patty, Peter P. Savage, and Stacy W. Greene, Spartan Aircraft Co.; Leo E. Cochran, L. D. Supply Co.; Ralph R. Renouf, Service Engineering Enterprises, Inc.

ON JUNE 29 an even 125 ASTE boosters gathered at the Cobblestone Hotel in the Springbank section of London, Ont., to see the 91st chapter established as London-St. Thomas and District.

Following dinner Executive Secretary Conrad opened the meeting and accepted for the Society the chapter's choice of officers. The Nominating Committee submitting the unanimously approved report was composed of Fred Lewis, chairman, tool designer, The Weatherhead Co. of Canada, Ltd., St. Thomas; Gordon Roberts, toolroom foreman, Pumps and Softeners, and Alfred Trueman, supervisor of tool engineering, General Motors Diesel, Ltd., both of London.

Ward Heads New Chapter

Chosen to conduct the chapter's affairs are: Chairman, Albert H. Ward, project development engineer, General Motors Diesel, Ltd., first vice-chairman, Louis Jensen, vice-president and general manager, Kelco Engineering, Ltd., both of London; second vice-chairman, W. Harold Brannan, The Weatherhead Co. of Canada, Ltd., St. Thomas; third vice-chairman, W. G. Lyon, tool engineer, Kelvinator of Canada, Ltd., treasurer, Alfred Trueman, and secretary, Thomas L. Pherigo, chief product development engineer, General Steel Wares, Ltd., all of London.

L. B. Bellamy of Detroit, first vice-president, installed the officers and read the charter before presenting it to Chairman Ward. A chairman emblem was pinned on Mr. Ward by Harry H. Whitehall of Galt, Canadian member of the National Membership Committee.

Mr. Whitehall in turn was "knighted Sir Harry" with a collar of silver dollars by Thomas J. Donovan, Jr., of Philadelphia, third vice-president. The knighting was in recognition of Mr. Whitehall's efforts in organizing the new group.

Donovan Puts on Technical Quiz

Entertaining with his "Silver Dollar Quiz," Mr. Donovan rewarded answers to technical and general interest questions with cartwheels in leather cases stamped as a souvenir of the occasion. Arthur Trybus, a Detroit chapter member, assisted Mr. Donovan by roving through the audience with a microphone.

On behalf of the chapter Walter A. Knoepfli, machine shop foreman at Somerville, Ltd., Crumlin, thanked Mr. Donovan for his educational program.

The honor of receiving the first of the National Membership Committee's new kits for supplies and samples went to William F. Hutcheson, membership chairman.

Guests included Douglas Cooper, John Yorick, Fred Dunn, and Harold Chambers, chairmen of Toronto, Hamilton, Niagara District, and Windsor chapters, respectively; representatives of the local press, and Doris B. Pratt, ASTE News editor of *The Tool Engineer*.

Chairman Ward presented gifts to Mr. Donovan and Miss Pratt and awarded door prizes to Robert Fraser, editorial chairman; George Foster, Hector Tompkins, and Lawrence Buchanan.

Harold Brannan, second vice-chairman, read congratulatory messages from A. B. Clark of Cleveland, national membership chairman; M. Chambers, Mr. Dunn, J. E. Orton of Toronto, Harry Sehl, Grand River Valley chapter chairman; Harry Ireland of Guelph Stove Co., Guelph, and F. Taylor, factory manager of Waterloo Mfg. Co., Ltd. Most of the comm

Reginald Bruce of the new London-St. Thomas chapter answers questions on T. J. Donovan's "Silver Dollar Quiz" as Arthur Trybus of Detroit chapter assists with a roving mike.

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tions from Canadian chapters and forms were accompanied with checks to swell the chapter treasury. Mr. Cooper brought greetings in person and a contribution from Toronto chapter.

At the close of the meeting the chapter executives met with the national officers.

Charter Members Total 112

Others making up the charter membership of 112 are: Robert M. Cornish, Beverley S. McDonald, Gordon Wise, Paul E. Long, John D. Ferguson, John H. Ayre, Charles Vergison, Robert L. Reid, John K. Patrick, Lawrence E. Buchanan, Granville Wood, William R. Walton, Norman D. Wong, Alfred T. Reed, James W. Kagawa, Henry G. V. Welch, George W. McLennan, John D. Fleming, Howard P. Lansing, Leonard R. Allingham.

Robert F. Dockstader, Charles G. Howson, Frederick A. Mitchell, Harry H. Moses, George T. Neely, Hugh Nisbet, Cecil Ward, Gordon A. White, and Howard E. Hathaway, General Motors Diesel, Ltd.; David B. Fay, Robert C. Fraser, Kenneth R. Sullivan, Stanley A. Willis, Howard D. Ramey, Jack A. Romanson, D. T. Van Buskirk, George I. Johnston, and Richard H. Grimster, Empire Brass Mfg. Co., Ltd.

* * *

George Fletcher, John E. Jessop, Joseph R. Jones, Arthur Edwards, Reginald E. Hallett, Frederick S. Hummel, William E. Smith, and Robert W. Wright, General Steel Wares, Ltd.; Clifford M. Webb, Earl A. Robilliard, Frank Galloway, Calvin G. Anderson, Armond A. Favaloro, Roy A. Conn, Joseph W. Cott, Frederick R. Newport, and Richard T. Tustin, Richards Wilcox of Canada.

Stanley C. Lindsay, Wilfred H. McKee, and George J. Twiddy, Kemp Products, Ltd.; George J. Pampu and John D. McLachlan, Capitol Records; Herbert H. Smith, Duro, Ltd.; Arne Nielsen and Omar R. Kilburn, Kelco Engineering, Ltd.; Kenneth V. Bilton and James J. Rogers, Eaton Automotive Products, Ltd.

* * *

John R. Skinner and Bruce E. Toll, Dennisteel Corp.; Warren K. Hammond, Hugh A. Childs, and Floyd H. King, Kelvinator of Canada, Ltd.; Jess W. Pawley and Arthur T. Jones, London Concrete Machinery Co.; Douglas M. Irving, Unifin Tube Co.; Hector C. Tompkins, Spramotor, Ltd.

Frederick Harrison, Taylor Electric Mfg. Co., Ltd.; William F. Hutcheson, Canadian Fairbanks Morse, Ltd.; Raymond E. Barton, Canadian Mines Equipment Co., Ltd.; Patrick J. O'Hare, Parker Pen Co.; Victor H. Nolan, N & L Machine & Equipment Co.; Thomas J. Carson, J. Carson & Sons; Roy Hind, Bach Simpson Co.; Joseph Tornabuono, London Metallizing & Machine Shop, and George L. Foster, Sparton of Canada, all of London.

James B. Brannen, James L. Hawes, and Clayton V. Pearce, Clevite, Ltd.; Richard V. Courrier, John C. Ayling, Teodor Hrabowsky, Reginald H. Bruce, Lloyd D. Campbell, Henry J. Keating, Allen R. Wicks, and D. F. McGraw, Timken Roller Bearing Co.; Roy L. O'Connor, Allen F. Deverell, Russell G. Jewell, George W. Herr, and Steward C. Chalk, The Weatherhead Co. of Canada, all of St. Thomas.

Harry H. Whitehall, H. H. Whitehall, Ltd., Galt; Bertrand J. E. Blair, E. F. Houghton & Co. of Canada, and Victor W. Hall, Modern Tool Works, both of Toronto, and A. Roy Brown.

R. G. Friedman of National Machinery Co. makes a tablecloth drawing to illustrate point in cold forging technique for group of Des Moines members, following his talk on this subject.

Chrysler Names Wilcox To Administrative Post

Detroit, Mich.—Grant S. Wilcox, Jr., has been appointed to the subsidiary operations staff of Chrysler Corp., under I. T. O'Brien, assistant general manager and in charge of subsidiaries, directly assisting Herman L. Weckler, vice-president and general manager.

In his new capacity Mr. Wilcox is helping to direct the administration of those subsidiaries that are not full divisions of the corporation.

Since the first of the year he has been assigned to the general offices, working on special products planning. Previously he was assistant factory manager at the Plymouth Division.

A member of the ASTE National Standards Committee, Mr. Wilcox is a former Society director. He is also the retiring president and a director of the Engineering Society of Detroit.

Modernization Survey Goes to Show Exhibitors

Nearly 4000 former and prospective exhibitors at ASTE expositions have received the Society's booklet, "Something Happened in 1950."

A study of current, continuing, and contemplated factory modernization programs, the brochure gives graphic breakdowns by industries. Executives are classified by groups in their influence for initiating projects, their responsibility for administering plans, recommending process changes, and selecting equipment.

The greatest single influence, the survey reveals, is the tool engineer, whose responsibility is as high as 100 percent in some industries.

The booklet is available on request to H. E. Conrad, executive secretary, American Society of Took Engineers, 10700 Puritan Ave., Detroit 21, Mich.

More than 200 exhibitors already have reserved space for the 1952 Tool Engineers Exposition at Chicago, March 17-21.

Explains Cold Forging

Des Moines, Iowa—R. G. Friedman, vice-president of the National Machinery Co., Tiffin, Ohio, addressed 55 members and guests of Des Moines chapter, May 16, on the subject of "Modern Cold Forging."

Mr. Friedman outlined the history and present applications of cold forging methods, explained limitations of the process, and made predictions about its future. He supplemented his talk with an exhibit of cold forged parts and two thorough, well photographed color films of operations performed by cold forging machines.

Hamilton Members Tour Canadian Diesel Engine Plant Tooled Up to Turn Out One Locomotive Unit per Day

Hamilton, Ont.—In 16 months Canadian manpower and skill built a diesel plant from the ground up and turned out 30 railroad engines—a plant that will hit a production stride of one locomotive unit per day, in six types ranging from 600 to 1500 hp.

Hamilton members took pride in this achievement as it was related to them while inspecting the modern methods and tools used in the General Motors Diesel, Ltd. plant at London, May 22.

Approximately 100 members from Hamilton and Brantford made the bus trip to London. Before visiting the plant they stopped for dinner at the Palm Grove Restaurant.

At the end of the tour refreshments were served in the company cafeteria, where a brief business meeting was held.

Gordon Hall, a past chairman, introduced D. A. Coape-Arnold, assistant chief engineer at the plant, who spoke on "Dieselization of Canadian Railroads." Mr. Coape-Arnold stressed historical and economic aspects of this revolution in transportation motive power.

Frank C. Johnson, program chairman, thanked the speaker, and members of the staff who acted as tour guides. John Yorick, chapter chairman, expressed the chapter's appreciation of the company's hospitality.

C. B. Dick (left), works manager of the East Springfield plant of Westinghouse Electric Corp., chats with V. H. Ericson, Society director; Jason Doubleday, chapter chairman, and Warren Crockwell of the Engineering Research Club of Springfield, when the Springfield, Mass., tool engineer and research groups were plant tour guests.

Springfield, Mass.—For its May 14 meeting Springfield chapter toured the Westinghouse plant in East Springfield.

Following dinner in the company cafeteria, the ASTE members and their guests of the Engineering Research Club of Springfield adjourned to the auditorium, where they were welcomed by C. B. Dick, works manager.

Mr. Dick introduced Milton Kalischer, who spoke on "Design of Household Appliances," and Edward Griffiths of the East Pittsburgh plant, who discussed "Metal Stampings and Die Maintenance Problems."

Conducted by Ernest J. Hills, the Union Twist Drill Co. Employees Glee Club of Athol entertained after the speaking program. The singers appeared through the courtesy of the Johnson-DeVou Co., by Victor H. Ericson, president and sales manager.

Cedar Rapids, Iowa—A Cedar Rapids chapter party of more than 200 members, wives and other guests saw wool cleaned, sorted, combed, carded, spun, and woven into cloth in the mills of the Amana Society at Amana, May 25.

A torrential rain did not discourage attendance as Amana woolens and food are equally famed for quality. Dinner at the Ox Yoke Inn was accompanied with zither selections by the Dietrich twins.

Following the meal the visitors adjourned to the community hall to hear Martin Dickle trace the Amana development from a benevolent communistic enterprise to the present corporation operating some 25,000 acres of land, a woolen mill, furniture factory, packing plant, and bakery. Until recently the society also manufactured refrigerators, and air conditioning units.

Amana hams, bacon, and other meat products were drawn as door prizes, seven to men and seven to ladies. The remainder of the evening was spent in dancing.

Two busloads of members gathered June 20 at the local bus depot for a t to Waterloo, where they were join by out-of-town members and guests a chapter dinner meeting at Blac Tearoom.

After dinner the group of 103 m toured the John Deere Waterloo Tra tor Works. They viewed the trac assembly line, the foundry, machi shops, toolmaking and gage shops, a the laboratories. Members of the co pany's tool engineering and metho departments served as guides.

Mechanized Foundry Is Highlight

Interest centered around the mode highly mechanized foundry, as few the visitors were familiar with th work. The next day many still we discussing sand slingers, roll-over co makers, and monorail-transported l dles.

One unusual feature was the se glareless, mercury vapor lighting some of the gage cribs. The enginee felt ill at ease under the yellowis green glow which imparts a ghast appearance to human flesh.

Housed in approximately 50 buil ings, the plant covers 43 acres and e ploys over 7000 persons. In their tw and one-half mile hike through th factory, the ASTE men had many o portunities for comparing these mas precision metalworking operations wi their own methods.

Pontiac, Mich.—Through the hosp tality of Pontiac Motor Div., Genera Motors Corp., local tool engineers ha an opportunity to see one of the mos up-to-date foundries in the country. On May 21 the chapter spent an evening studying all phases of this operation.

Among highlights was the metho employed to briquette cast iron and steel scrap for re-use in the furnaces.

Evansville, Ind.—Accustomed to plant tours of heavy industrial manu facturing, Evansville ASTE'ers had a novel experience when they saw how two of their fellow members had adapted tool engineering to applied art. More than 75 members and guests journeyed to Newburgh, June 11, to visit Engle Studio.

See Tooling for Ceramics

Walter Messick and Dana Coy partners in making delicate figures and other ceramic products, showed the Evansville visitors through one of few such plants located outside of Cali fornia.

Before the tour the party had dinner at the American Legion Home. As program chairman, Mr. Messick ex plained details and processes involved in manufacturing ceramic art goods. He demonstrated with samples and

During visit of their fellow members in Evansville chapter, Walter Messick (left) and Dana Cope, partners in Engle Studio, show a piece of the ceramic artware they manufacture.

molds, and described various clay mixtures and their application.

Ann Arbor, Mich.—In its program of observing modern production and engineering practices as utilized by local industries, Waterloo Area chapter visited the American Broach Co. plant on May 23.

Films, depicting broaching principles and special applications of broaching equipment previewed the inspection of the manufacture and assembly of this machinery. Prior to the tour the 143 members and guests participating had dinner at the plant.

Wichita, Kans.—Cardwell Mfg. Co. held open house to 73 Wichita members and guests for a plant tour, June 13.

Here the tool engineers saw massive, well-designed manufacturing and handling machinery to build oil field servicing and drilling equipment.

Before inspecting the plant the ASTE group heard William Barnhart of the Cardwell staff review the company's background, its operations, and products, made largely for export.

The chapter had as guest speakers ASTE President J. J. Demuth and Executive Secretary H. E. Conrad. Mr. Demuth talked inspiringly on the practice and future of tool engineering. Mr. Conrad explained the organization's services and projects.

Peiffer With Firestone

Akron, Ohio—Harold E. Peiffer has joined the Defense Research Division of Firestone Tire & Rubber Co. In connection with his duties as research project engineer in the development of production methods, he has charge of the defense research experimental shop.

Formerly chief engineer at Cleveland Duplex Machinery Co., Inc., Mr. Peiffer is prominent in the Cleveland ASTE chapter and in other engineering groups. He is the author of several articles on special tooling.

St. Louis to Charter Transportation to Evansville

St. Louis, Mo.—To carry the enthusiastic delegation of members and wives expected to attend the first area membership meeting, at Evansville, Ind., October 19-20, St. Louis chapter is arranging for special railroad accommodations. L. W. Greenblatt, chapter chairman and a member of the Evansville meeting planning committee, made this announcement in discussing the chapter's participation in the two-day meeting.

E. P. Huchzermeier, first vice-chairman of the chapter, is heading a committee to handle transportation, hotel and other reservations, and details. To build as large an attendance as possible, I. J. Schumaier, program chairman, is working on a membership mailing.

Want Defense Tooling Subjects

The St. Louis tool engineers indicate a program preference for technical talks concerned with defense production. During their stay at Evansville they would like to inspect facilities of local firms engaged in the production of refrigeration units, industrial lifting equipment, and marine products.

Charles H. Thuman, Evansville chapter chairman, is coordinator of the committee composed of representatives of 12 South Central area chapters. Others on this committee are: Lawrence R. McAfee, Dayton; Leslie Mendenhall, Muncie; Dezell Gibbs, Richmond; William D. Wuest, Louisville; James W. Clark, Decatur; A. Scobey Rogers, Nashville; Ernest W. Hilkenbach, Indianapolis; Duane H. Brighton, Peoria; Edgar L. Routzong, Cincinnati, and Roger W. Wallace, Springfield, Ill., all chairmen of their respective chapters.

Mr. McAfee reports that his members request technical papers on Blanking and Forming Dies, Tool Steel and Applications, Plastic Mold Design, Gaging, and Jig and Fixture Design.

Plans of the other participating chapters have not been announced.

Situation Wanted

TOOL SUPERINTENDENT OR CHIEF TOOL DESIGNER—Age 33; 15 years' tooling background as toolmaker, tool engineer, and tool supervisor. Extensive experience in product and tool design, tool planning, processing, estimating, purchasing, liaison with outside suppliers, and follow-up. Desires responsible management or engineering position. Minimum acceptable salary, $7200. Resume on request. Box 238. American Society of Tool Engineers, 10700 Puritan Ave., Detroit 21, Mich.

Talks on Tool Metallurgy

Binghamton, N. Y.—Prof. J. O. Jefferies of Cornell University was guest speaker at Binghamton chapter's June 1 meeting in Statler Hall on the campus.

Fifty-two members and guests of the chapter heard the professor discuss metallurgical aspects of tool design.

New Data Sheets on Way To Society Membership

Detroit, Mich.—Product data sheets from three manufacturers are being distributed to ASTE members this month by the National Standards Committee, chairmanned by Raymond C. Peterson, manager of Peterson Engineering Co., Toledo, Ohio.

The mailing from national headquarters includes one sheet on live centers from Sturdimatic Tool Co., Detroit; three sheets on flexible metal hose by American Metal Hose Branch, American Brass Co., Waterbury, Conn., and a revision of a sheet on welding electrodes issued by The Lincoln Electric Co., Cleveland, Ohio.

In June the committee sent out 11 sheets from Acme Industrial Co., Boyar-Schultz Corp., Conner Tool and Cutter Co., and Univertical Machine Co.

Advances in investment casting and aluminum die casting are described to Boston members by R. L. Wood (left) of Arwood Precision Casting Co. and J. C. Fox of Doehler-Jarvis Corp., respectively.

Casting Advances Told

Boston, Mass.—Two experts in their respective fields brought a gold-mine of information on casting practices and procedures to the final meeting of the Boston chapter season, May 10, in New England Mutual Hall.

J. C. Fox, chief metallurgist, Doehler-Jarvis Corp., discussed "Aluminum Die Castings," and R. L. Wood, president, Arwood Precision Casting Co., Brooklyn, N. Y., talked on the companion subject, "Investment Castings."

The perfecting of the new methods and applications explained comes at a time when maximum efficiency and conservation of raw materials is demanded.

Chicago Wives Plan Ladies 1952 Convention Program

Chicago, Ill.—Wives of Chicago members serving on the 1952 annual meeting committee have organized a tentative ladies program for the ASTE convention and exposition in that city, March 17-21.

Headed by Mrs. Richard Miller as chairman, the women's division will function as follows: Mrs. Walter Haskins, registration chairman, assisted by the Mrs. Clifford E. Ives, T. C. Barber, George W. Steinmetz, Waldo Schmitt, A. L. Winkler, Frank A. Leone, and A. Howard Ettinger.

Mrs. Barber is coordinator of transportation and will also arrange a tour of something native to Chicago.

Hostess for a get-acquainted breakfast, March 18, at the Stevens Hotel and a subsequent visit to Don McNeil's Breakfast Club will be Mrs. Ives. Following the radio show, Mrs. Harry Paine will conduct the out-of-town ladies on a sightseeing bus tour.

Mrs. Ettinger and Mrs. Winkler are in charge of tours of the Field and the Science and Industry museums, respectively.

Mrs. F. J. Schmitt, assisted by the Mrs. Leone and Winkler, is chairman of a luncheon and fashion show at Marshall Field's. After the luncheon party, Mrs. C. C. Waldo will head up a behind-the-scenes tour of the store.

Arrangements for a tour of the Chicago Tribune building have been assigned to Mrs. Leone. Mrs. Jerry Tannenbaum will have theatre, radio and TV show tickets.

Mrs. Steinmetz serves as secretary to Mrs. Miller and as chairman of an unannounced tour.

The committee invites wives of other ASTE members to attend future planning meetings.

Stimson Shows New Ways Of Inspecting Threads

Los Angeles, Calif.—The latest methods of inspecting screw threads were demonstrated to 185 members and guests of Los Angeles chapter with slides shown by Glen H. Stimson, chief engineer of the Gage Div., Greenfield Tap & Die Corp. Mr. Stimson used these illustrations in connection with his talk on the "Development of the Unified Screw Thread System," given June 14 at a dinner meeting in Scully's Cafe.

In recognition of his untiring efforts and contributions to the advancement of the chapter, Wayne Ewing, immediate past chairman, was presented with an engraved plaque.

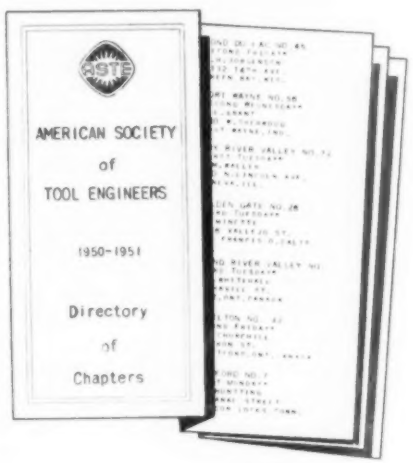
Present as guests of Carl W. Barnthouse, industrial relations chairman, were: George W. MacKinzie, supervisor, trade and industrial education, Los Angeles; John Doerman, industrial trades counsellor, Huntington Park High School; Jan W. Pluim, industrial trades counsellor, South Gate High School; George Merrick, machine shop instructor, Van Nuys High School, and Harry Simonds, coordinator, Metal Trades Los Angeles City School.

The local educators were favorably impressed with the scope of the Society's activities. Future plans include abundant exchange of assistance between the Los Angeles area schools and the chapter.

New Chapter Directory

Detroit, Mich.—A 1951-52 edition of the pocket directory of ASTE chapters has been issued by Society headquarters.

The wallet-sized roster lists each chapter by name and number, its meeting night, and the chairman's address and telephone number.



A copy will be included in a mailing of data sheets going to each member this month.

Dundore Opens New Plant

Baltimore, Md.—Harry A. Dundore of Baltimore chapter, owner and operator of Diecraft, announces the opening of a newly constructed plant just outside Baltimore.

At the formal opening ceremonies on June 16, Mr. Dundore stated that this was the third time the firm had moved to larger quarters since its establishment in 1932.

Merrill S. Matson, also a Baltimore member, is general manager of Diecraft. Ninety-five percent of the company's current output, he reports, is for the armed services. Present products include aircraft parts, electronics and communications equipment, and ordnance components.

Secretary Issues Count On Amendment Balloting

Detroit, Mich.—Official count on the recent membership voting on constitutional amendments has been announced by National Secretary W. A. Thomas as follows:

Amendments A, B, and C (Research Fund approval)—Yes 2361, no 85, total 2449; D (Senior membership voting and ownership rights)—Yes 2712, no 22, total 2734; E (Closes Junior membership to students, clarifies Junior voting and ownership rights)—Yes 2153, no 521, total 2674; F (Removes student age limit)—Yes 2536, no 149, total 2685.

Amendment G (Provides for the president's admission to life membership to cover contingency of re-election)—Yes 2636, no 224, total 2860; H (Requirement for assignment to higher grade to which member is qualified)—Yes 2636, no 73, total 2709; I (Stipulation for mandatory election of first vice president)—Yes 2689, no 16, total 2705; J (Correction of clerical error in procedure for processing constitutional amendments)—Yes 2708, no 3, total 2711.

The 30-day period allowed for voting on these amendments closed at midnight, May 12.

The July *Tool Engineer* erroneously reported that an amendment lowering the minimum age for Senior membership from 25 to 21 years had been ratified. Originally listed as "Amendment D," this proposal was defeated in the preliminary voting by chapter constitution and by-laws committees. Amendment E was then designated "D" and all subsequent items were re-identified accordingly on the ballot submitted to the membership.

Cope Simplifies Approach To Drawing Die Design

Peoria, Ill.—Stanley R. Cope, president of Acme School of Die Design Engineering and of Colfax Tool Engineering Co., South Bend, Ind., drew an audience of approximately 250 Peoria tool engineers when he lectured on "Design of Deep Drawing Dies," June 7, at a chapter meeting in the Pabst Brewing Co. auditorium.

With slides, Mr. Cope showed how the intricacies of die design can be reduced to a series of clearly defined principles. He passed along to his listeners valuable tips on designing dies, and exhibited a large display of die form parts.

Walter J. Kamp, supervisor of die design at Caterpillar Tractor Co., introduced Mr. Cope. At the close of the meeting refreshments were served by the host company.

On its 13th anniversary Rochester chapter turned out to honor its past chairmen, from left, front row: Joseph Schick, Clifford Sears, Cecil Lucas, John Dense, Charles Codd, and John Bartek; back row: William Gordon, Emmett Moore, Charles Seely, Earle DeBisschop, Chauncey Newton, Milton Roessel, and Herbert O. Simon.

Three Chapters Observe 13th Anniversary of Founding

Dayton, Cincinnati, and Rochester chapters celebrated their 13th anniversaries with May dinner parties. The two Ohio groups had President J. J. Demuth and Executive Secretary H. E. Conrad as guests of honor.

Also special guests at the Dayton function, held May 14 at the Miami Hotel, were: George Tillotson, E. J. Seifreat, Adam Lensch, Walter Olt, Earl Johnson, George Goodwin, H. O. Poock, and C. R. Miller, all past chairmen.

Mr. Demuth and Mr. Conrad explained the Society's services, its efforts to promote tool engineering education, and new projects now under way.

Goodwin Gets ASTE Necktie

In recognition of outstanding service as former national treasurer, Mr. Demuth presented Mr. Goodwin with a handpainted necktie bearing the ASTE emblem, money bags and a dollar sign.

As coffee speaker Robert Hall of the Pfeiffer Brewing Co. amused the 65 men present with humorous stories.

Several acts of professional entertainment concluded the program.

THE WORK of our schools, civic government, and churches suffers from the indifference of individuals, Mason M. Roberts, vice-president, General Motors Corp., and general manager, Frigidaire Div., told Cincinnati's birthday dinner audience. Mr. Mason spoke May 5 at Hotel Alms.

Inventory Latent Abilities

By taking personal inventory and using our "hidden adequacies," we can help advance the cause of humanity in these activities, Mr. Mason declared.

Considered practically an honorary member of the chapter, Judge James G. Stewart of the Supreme Court of Ohio gave his annual talk on "Fellow Tool Engineers." Judge Stewart claims to know nothing about tool engineering, and as such his talk is always eagerly anticipated.

George F. Bradley, retiring chairman, introduced the following new officers: Edgar L. Routzong, chairman; Joseph Aprile, first vice-chairman; Richard B. Niebusch, second vice-chairman; Joseph C. Maezer, secretary, and Walter R. DeRoche, treasurer. Mr. Routzong presented a past chairman pin to Mr. Bradley.

Some 35 door prizes were awarded at the conclusion of the meeting.

Charles DeMartin, Rochester first vice-chairman, introduced the chapter's former chief executives to the approximately 100 members and guests present to honor them at the annual past chairman night, held May 7 at the Liederkranz Club.

All Past Chairmen Present

In the order of their tenure of office, from 1938 through 1950, they are: John Bartek, Charles E. Codd, John Dense, Cecil Lucas, Clifford M. Sears, Chauncey G. Newton, Joseph H. Schick, Earle W. DeBisschop, Charles E. Seely, Milton L. Roessel, Herbert O. Simon, William R. Gordon, and Emmett W. Moore.

Chairman J. O. Horne extended his greetings to the group and paid tribute to their role in building the chapter's present strong foundation.

The Society's progress and its plans for the future were detailed by H. E. Conrad, executive secretary.

Reports on Korean Situation

Donald Kohler, second vice-chairman, introduced Col. Ward L. Hamilton, transportation director for the Military Government in Korea.

Colonel Hamilton traced the 40-century background of the Korean people. His discussion of the peninsula's geographic position in Asia, its economics, natural resources, and present situation in global events brought home to his listeners the tremendous task facing the world in its quest for peace.

ST. LOUIS, MO.—Approximately 165 St. Louis members and their women guests met at the DeSoto Hotel, June 12, for the chapter's first ladies night.

Another 35 persons joined the party, after the buffet dinner, to hear Martin Hughes, a professional lecturer from Chicago. The group was pleasantly entertained by Mr. Hughes' reminiscences of some of his unusual experiences.

Before leaving the meeting the party saw a motion picture of the 1950 chapter picnic.

Two Ohio chapters observe their 13th anniversaries with May dinners. Left: Principal figures at Cincinnati's birthday party, from left, seated: Judge James G. Stewart and Mason M. Roberts of General Motors Corp. (speakers), Edgar L. Routzong, chairman, and J. J. Demuth, Society president; standing: Walter R. DeRoche, Richard B. Niebusch, George F. Bradley, Joseph Aprile, and Joseph C. Maezer, past chairmen.

Incas Surgical Technique Used to Produce Armament

Detroit, Mich.—A method that the ancient Incas and primitive peoples through the ages have used to relieve epilepsy, headache, and other ailments is being adapted to produce cannon tubes.

Employing an apple coring technique, the Peru indians removed a circular portion of the skull with a red-hot, cylindrical iron punch, to permit evil spirits to escape. This first recorded surgery was the forerunner of the medical profession's present trepanning operation.

Center Left Intact

Applied to military production, the process consists of machining an annular hole in a solid rolled or forged bar, leaving the center untouched. A tubular cutting head, mounting a single-point cutter and appropriate wear inserts, is the tool used. As compared with spade drilling, chips are reduced, cutting energy conserved, and cutting speeds increased.

This was one of the outstanding "New Production Methods and Tools in Ordnance Manufacture" described by Gen. Merle H. Davis, Chief of the Ammunition Branch, Industrial Division of Army Ordnance, Washington, D. C., to several hundred Detroit members and industrialists, June 14. The Flag Day chapter dinner meeting was held at the Engineering Society of Detroit.

The General singled out three other methods for discussion. In multiple-ram, closed-die forging, a new technique developed to make heavy valve bodies for oil well equipment is being applied to the manufacture of breech rings for major caliber cannon. Ductility has been improved up to 200 percent; at yield strengths over 100,000 psi, impact resistance has been strengthened as much as 150 percent, while costs have been cut in two, he reported.

For infantry mortar tubes and some rockets, General Davis continued, tubing must be straight, perfectly round in interior cross-section, and with reasonably uniform wall thickness. While a carbide ball can be forced through a short piece of tubing to size the inside and to obtain a round cross-section, it does nothing for straightness nor for concentricity.

Most successful three-in-one operation yet devised is a composite ram made up of a series of graduated rings. The sizing rings in this broach-like tool are interspersed with smaller rings around which oil circulates. By pushing the ram in and out through tubing of a predetermined smaller I.D. than the desired end product, the tube is made round, straight, and accurately sized on the inside. Locating from this finished interior surface, it's easy to turn off the exterior for a uniform wall.

High speed machining, credited by the General to Detroit industry, has been exploited for arms production only in "sporadic and scattered" cases. Rather, ordnance is concentrating its efforts on processes to save machining.

Founders Eliminate Machining

In the competition of processes, working ruthlessly as the law of the jungle, foundrymen have come back with a device that commands attention. Some call it "shell casting," others, "resin-sand molding." Here, savings result through elimination of machining, together with a good cast finish.

"Our World War II attempt to substitute steel for brass in cartridge cases was a flop," General Davis admitted. "Now we have this problem licked. Except for some of the smaller calibers, every type of cartridge case can be made from steel, to outperform its brass counterpart."

Cartridge case contractors are eager to apply cold drawing to other ammunition items, including projectiles. One manufacturer, cited by the General, is fabricating a mortar shell by hot forging a cup, then cold drawing a shell from the cup. He apparently can compete with cold extrusion contractors.

General Merle H. Davis, Pentagon ammunition chief, tells Detroit members how Ordnance uses trepanning to machine cannon tubes

Although security restricts release of information on government contracts, extruding practices, the ammunition chief revealed that extruding is the "most advanced method we have for the production of projectiles."

No longer a storehouse of raw materials, this country has joined the have-nots. As yet our defense output is only about one-fifth of what it would be in a general mobilization. When we hit full production, we must meet the challenge to our resourcefulness, the speaker declared.

At the close of his address General Davis answered questions concerning application of the methods discussed.

Chairman John D. Anderson opened the meeting, then turned it over to immediate Past Chairman Charles E. Smillie, program chairman.

Deplores Moral Decline

Rev. G. Paul Musselman, pastor of the Mariners Church, offered the invocation and gave the coffee talk. After entertaining his audience with humorous anecdotes directed at the head table "gold braid," the clergyman referred to the moral deterioration of our times. "The close tolerances of industry must be applied to morals," he asserted. "It is private immorality which lays the groundwork for public subversion."

Speakers' table guests included Maj. Gen. David J. Crawford, commanding general, Ordnance Tank Automotive Center; Col. W. A. Call, chief, development and engineering department; Lt. Col. John M. Cone, deputy district chief; Lt. Col. Paul C. Ronayne of General Crawford's staff, and Lt. Col. Peter Jensen, industrial miscellaneous branch, all of the Detroit Ordnance District.

Also R. J. Emmert, executive in charge of facilities and processes sections, and C. W. Moyer, defense plants coordinator for Fisher Body Div., both of General Motors Corp.; D. J. Dunn, director, manufacturing engineering office, Richard E. Krafve, director

Head table guests at Detroit meeting on Ordnance production included, from left: Col. Paul C. Ronayne of Detroit Tank Arsenal; L. K. Marshall, Lincoln-Mercury Div., Ford Motor Co.; Rev. G. P. Musselman, coffee speaker; H. T. Bodman, National Bank of Detroit, and J. W. Wagus, chapter treasurer.

...nse prod... and A. C. Moore, ...eral manag... Tank Division, all of ... Motor C...

... K. Mar...all, manager, defense ...duction operations, gas turbine ...t, and Ray P. Powers, manager, ...ward product... production engineering department, both of the Ford Lincoln-Mercury Division.

Robert Bilton, production manager, Fruehauf Trailer Co.; William Grier, assistant regional manager, National Association of Manufacturers; Henry T. Bodman, general vice-president, National Bank of Detroit, and E. V. Crane, chief engineer, E. W. Bliss Co., Toledo.

The Society was represented by Leslie B. Bellamy, first vice-president; Roger F. Waindle, second vice-president; Herbert L. Tigges, immediate past president; Otto W. Winter, a past president, and Grant S. Wilcox, Jr. of the National Standards Committee, in addition to chapter officers and committee chairmen.

Tigges Named Director Of NPA Division

Washington, D. C.—Herbert L. Tigges, executive vice-president of Baker Bros., Toledo, Ohio, and immediate past president of ASTE, has been made acting director of the General Industry Equipment Division of NPA.

He succeeds Marshall M. Smith who has returned to his private business capacity of vice-president of E. W. Bliss Co., also of Toledo.

Mr. Tigges will be in Washington full time, with an office in the new General Accounting Office Building. Until recently he was a part-time consultant to the Metalworking Machinery Branch of the General Industry Equipment Division.

Uses Air Gage Tracers For Automatic Turning

Syracuse, N.Y.—Approximately 150 Syracuse members and guests gathered June 12 at the Deauville Hotel on Owasco Lake at Auburn for the closing dinner meeting of the chapter season.

Stanley A. Brandenburg, vice-president and sales manager, Monarch Machine Tool Co., was introduced as the technical speaker by Harold Emerick of the H. A. Smith Machinery Co.

In relating "Latest Developments in Turning Machines," Mr. Brandenburg covered the use of air gage tracers in automatic turning. Examples of current products were illustrated in sound film. A lively discussion followed.

Albert Vesper, program chairman, assisted by John Dugan of Auburn, was in charge of this outstanding annual event. Although scheduled for hospitalization, Mr. Vesper stayed on long enough to complete the arrangements.

Peterson Visits England With Stamping Experts

Toledo, Ohio—Raymond C. Peterson, manager of Peterson Engineering Co., Toledo, and chairman of the ASTE National Standards Committee, is a member of a 15-man team of pressed metal experts visiting English stamping plants.

The U.S. party are guests of the Economic Cooperation Administration and the United Kingdom Pressed Metals Industry. They will discuss mutual problems with British production men and attempt to assist each other through an exchange of ideas.

Will Visit At-Large Members

Mr. Peterson is also endeavoring to contact as many ASTE members in Britain as possible. They are: Erik S. Nordin, Robert J. Armstrong, and Harold T. Johnson, Vauxhall Motors, Ltd., Luton; H. M. Goodwin, Cincinnati Milling Machines, Ltd., Frederick Garner, Joseph Lucas, Ltd., and Alfred J. Worster, The Rover Co., Ltd., all of Birmingham.

Henry Hoyer, Lilford Technical School, Peter T. Howard, International Time Recording Co., Ltd., Paul Grodzinski, Industrial Distributors, Ltd., Maj. Gen. K. C. Appleyard, Institution of Production Engineers, George G. McGill, Waygood Otis, Ltd., and Hartwig Orenstein, industrial consultant, all of London.

Wayne R. Thomson, Caterpillar Tractor Co., Ltd., Leicester; Denis S. Player, Newall Engineering Co., Peterborough; Charles Burton, David Brown & Sons, Huddersfield, and Laurence H. Rhodes, Crawley Industrial Products, Crawley.

At the conclusion of the English tour, the ASTE standards chairman will visit relatives in Sweden. While there he will try to get in touch with the following Society members: E. L. Larsson, Albin Motor Co., Kristinehamn; Eric G. Redin, Ingeniorsfirma Eric Redin, Norrkoping; William E. Sjostedt, A/B Scania Vabis, Sodertalje; Eric G. Wennerlund, Allmänna Svenska Elektriska A/B; Rolf R. Hanson, Sandvikens Jernverks A/B, Sandviken, and Nils E. Goodrich, Fora, all of that country.

Fansteel Elects Clark

Chicago, Ill.—Herbert B. Clark was recently elected a director of Fansteel Metallurgical Corp. at the annual meeting of stockholders, Robert J. Aitchison, company president, has announced.

Since 1946 Mr. Clark has been serving as general manager of Vascoloy-Ramet Corp., a Fansteel subsidiary. He is a member of St. Louis chapter, ASTE.

New Grinding Methods Are Faster, Economical

Philadelphia, Pa.—Problems and benefits of grinding, with wheels, abrasive coated belts and discs, were presented to Philadelphia chapter, May 17, by Boyd H. Work and William Corse of the Carborundum Co. Mr. Work is assistant sales manager of the Bonded Products and Grain Division, while Mr. Corse is chief test engineer of the Coated Abrasive Division.

Motion pictures showing "on the job" performance in actual production studies illustrated the subject. Successful applications of coated paper and fabric belts are constantly increasing, according to Mr. Corse. Through economies in cooler grinding, greater productivity, and reduced abrasive cost, these installations have replaced wheel grinding apparatus.

Improved results have been obtained on abrasive belts, the speaker said, by using various tooth shaped gashes in the rubber wheels which back up the belt.

Among recent developments in coated abrasives reported by Mr. Corse, the tool engineers were particularly interested in laminated cloth wheels, permitting edge grinding as well as face grinding.

The technical program was attended by 146 members and guests. Before the meeting the Engineers Club staff served 86 at dinner.

Majernik Is President Of Engineering Club

George J. Majernik (left), an Evansville ASTE student section member, heads the Engineering Club at Evansville College. With him are Howard E. Blesch, Edwin A. Seibert, Lynn Brown, and Walter Shaw, also members of the club and of the chapter.

Is Chicago Sales Head

Chicago, Ill.—Leonard Becker, former grinding engineer with the Sterling Grinding Wheel Division of Cleveland Quarries, has been appointed Chicago sales manager by the Blanchard Diamond Tool Co.

Mr. Becker is affiliated with the Cincinnati ASTE chapter.

Outings, Sports Programs Replace Technical Talks

Flint, Mich.—Saginaw Valley chapter entertained Waterloo Area and Jackson ASTE'ers, June 16, with an outing at Shore Acres Golf Club on Lake Fenton.

About 120 members and guests of the three chapters gathered for a day of golf, baseball, horseshoes, and other contests.

Awards were made to winners of the sports events and a drawing was held to distribute door prizes. More than half of the picnickers went home with gifts, ranging from slide projectors, sport shirts, electric fans, and golf clubs, to six-inch scales, cigarette lighters, and pen and pencil sets.

An evening buffet lunch was topped off with entertainment and motion pictures.

CLEVELAND, OHIO—Bright weather favored Cleveland chapter for its annual golf party, June 8, at the Manakiki Country Club. One of the most scenic courses in the area, the Manakiki is a challenge to players.

Nearly 135 members and guests went around the green. An additional 20 joined them for the banquet following the afternoon's exercise.

Although prizes were lavishly distributed many remained to be given out at the Family Picnic on August 12.

PONTIAC, MICH.—Ben Hardesty, national bait and fly casting champion, gave an amazing demonstration of his skill before 100 Pontiac members and their friends at a meeting, June 21, at the Boys' Club.

Mr. Hardesty compared right and wrong methods of bait casting, and showed his technique in a display of trick casts. His color film, "Fishing for Fun," pictured him catching various kinds of fish.

Several pieces of fishing equipment were awarded as door prizes to lucky ticket holders.

During the evening the group was escorted through the recently opened Boys Club building. Members of the Mothers Club auxiliary served a buffet luncheon.

POUGHKEEPSIE, N. Y.—Mid-Hudson chapter drew a perfect day for its fifth annual picnic, June 8, at Shady Brook Park.

More than 270 members, their families and guests enjoyed an afternoon of swimming, baseball, and refreshments. After the games, a barbecued beef supper was served to the hungry players. Almost everyone received a door prize.

The committee in charge included Raymond Lansing, general chairman; J. Hunting Otis, picnic dinner; Richard Fitzgibbons, sports; Fred Hennings, prizes; Joseph Spahn, refreshments; Frank Plotnik and Edward Phalen, tickets.

NASHVILLE, TENN.—By getting a head start on fishing and boating, some of Nashville's members made an all-day event of the chapter's annual steak fry and outing, May 19, at Lester's Lake. One party was elated and disappointed as a three-pound bass was lifted out of the water—and plopped back in.

Officers of the chapter, assisted by members, prepared and served dinner. Following the outdoor meal, Lee Severy, accompanied by his ukelele, led the 50 or so men in group singing.

KANSAS CITY, MO.—"How to and How Not to Fish" was explained to 34 Kansas City members and their guests, by Luther (Bluegill) Blythe, tackleman for Gateway Sporting Goods Stores. Mr. Blythe spoke June 6 at a chapter meeting at Roselli's Restaurant.

After relating a number of personal experiences, he demonstrated the correct use of various types of equipment. The program ended with Mr. Blythe answering questions from the floor.

A representative of the Board of National Association of Scientific Anglers and the proponent of "Take a kid fishing," Mr. Blythe is active in providing this kind of recreation for boys and disabled veterans.

PITTSBURGH, PA.—Approximately 175 Pittsburgh tool engineers competed at games during the chapter's annual picnic, June 8, at the Daniels Farm.

Events included a horseshoe elimination contest, soft ball, golf driving and putting.

WILLIAMSPORT, PA.—June meeting Williamsport chapter was a picnic on the 21st at Shore Acres.

The 30 members and guests attending the outing enjoyed volley ball, quoits and swimming.

Harshbarger Transferred

New York City—Donald J. Harshbarger, formerly connected with Monarch Machine Tool Co.'s New York sales office, has been transferred to the company's Pittsburgh branch office. A. Brandenburg, vice-president, has announced.

With Monarch since 1936, Mr. Harshbarger is affiliated with the Greater New York chapter of ASTE.

Mid-Hudson members and their families relax under the trees of Shady Brook Park at the chapter's annual picnic. At center, William W. Schug (left), chapter chairman, and Ellis W. Thorp, a former chairman, watch a group inspecting the attendance prizes at right.

McLaughlin Is Alternate

A photograph of the installation of Long Island chapter's charter officers in the June *Tool Engineer*, showed one man unnamed. The chapter has since identified him as George J. McLaughlin, chapter alternate, and a tool engineer at Grumman Aircraft Engineering Corp., Bethpage, L.I.

Mr. McLaughlin was active in obtaining memberships to form the new group.

NPA Names Marsilius

Bridgeport, Conn.—Philip R. Marsilius, vice-president and secretary of The Producto Machine Co. of Bridgeport and president, The Producto Corp. of Detroit, has been named Chief of the Tool, Die, and Fixture Section, Machinery Division, National Production Authority.

A member of the Fairfield County ASTE chapter, Mr. Marsilius is a trustee of the National Tool and Die Manufacturers Association, and president of the Southern Connecticut Tool and Die Manufacturers Association.

from the Executive Secretary's Mailbag

Your headquarters staff is always striving to improve its service to you and to all the other 18,465 ASTE members. Sometimes we wonder how well we are succeeding. Whenever officers or members express themselves as in the following communications, we're encouraged to reach for new highs in production efficiency.

HARRY E. CONRAD,
Executive Secretary

The June issue of *The Tool Engineer* makes me very happy in its fulfillment of several of our overall publishing objectives. This achievement merits good reception from all of our national officers and committeemen.

Supplementing this the technical features, the *Andygrams* by Rylander, the complete national and chapter news coverage by Doris Pratt, and the arrangement in general, are outstanding. My compliments to the whole *Tool Engineer* staff for a good job.

I have said this many times and will say it again—I think this is a wonderful organization from every standpoint. As long as the present coordination exists, nothing can stop its progress. It gives me a great deal of pleasure to say so.

J. J. DEMUTH,
St. Louis, Mo. *President*

I recently received the directory of chapter officers and the minutes of the House of Delegates meeting held at New York.

Aside from the value of both of these documents per se, I could not miss this opportunity to write you about them.

Having been closely associated with the secretarial functions of business for many years, I know the amount of detail necessary to produce reports of this nature. The actual compilation of the data necessary to get out the chapter personnel list must have been a chore in itself. The typing, proofreading, and binding of the minutes of the House of Delegates was something not accomplished in a day, a week, or a month.

So—for the general excellence, accuracy, and fine appearance of the work turned out by you and your staff, sir—my compliments and congratulations!

ANDREW B. CLARK,
National Membership Chairman
Cleveland, Ohio

Air Power Ups Output, Cuts Operator Fatigue

Worcester, Mass.—Machine tool applications of air power, that have eliminated worker fatigue and increased production, were described to Worcester members, June 6, by Benton Larson and Don Guy, field engineers for the Bellows Co. A sound film picturing these case histories augmented their program.

Before the technical session Dan B. Wesson, assistant superintendent of Smith & Wesson, Inc., Springfield, Mass., talked briefly on "Making Revolvers in a Remarkable Plant," following with a color film of the Wesson plant. E. Roland Ljungquist, program chairman, introduced the speakers. The meeting opened with a smorgasbord.

Welding Repairs Tools Without Drawing Temper

Poughkeepsie, N. Y.—An important phase of tool repair was explained to 45 Mid-Hudson members, May 8, when John H. Poulson, regional manager for Eutectic Welding Alloys Corp., New York City, talked on "Tool and Die Welding and Salvage With Low-Melting, Non-Fusion Filler Metals."

Using slides, Mr. Poulson showed how almost invisible welds can be made without drawing the temper of the tool. A new and simple method of tool tipping also was demonstrated, along with tricks of the trade for difficult assembly jobs. As outlined by the speaker, current welding research is contributing longer life to tools.

The Indian was represented as America's first tool engineer in a coffee talk by Kenneth H. Mynter of Claverack, N. Y., an adopted member of the Mohawk nation, and an authority on Indian life in the Hudson Valley. The aborigines, he said, invented snowshoes, the canoe, chip basket, lacrosse stick, and some forms of beadwork.

William W. Schug, chapter chairman, presided. Attendance was 45.

French Engineers Make Kertesz Honorary Member

New York City—Carl Kertesz, immediate past chairman of Greater New York chapter, president of Kertes Mfg. Corp. and vice-president of Design Tool Corp., has been made an honorary member of the French Engineers in the United States.

The French organization exchanges visits with the New York ASTE group.

Coming Meetings

CHICAGO—March 17-21, 1952. Tool Engineers Industrial Exposition and 20th annual Society meeting.

CLEVELAND—September 14, Cleveland Hopkins Airport. Tour through Cadillac Motor Car Div., Cleveland Tank Plant. Tour limited to 200 members.

DES MOINES—September 19. Speaker: W. C. Lee, chief quality control engineer, Solar Aircraft Co. Subject: "How Statistical Quality Control Can Assist Tool Design and Methods Departments."

DETROIT—August 11, Glen Oaks Country Club. Golf party, lunch and dinner. September 19, Engineering Society of Detroit. Subject: "Wealth, Production and Machine Tools."

EVANSVILLE—October 19-20, Hotel Vendome. South Central area membership meeting and semi-annual meeting of board of directors.

LOS ANGELES—August 10, 8:00 p. m., Deauville Club, Santa Monica, Calif. Annual dinner dance, informal.

MILWAUKEE—September 13, 6:30 p. m., Elks Club. Speaker: Harris Ewald, chief engineer, Evinrude Motors. Subject: "Development of the Outboard Motor." Coffee Speaker: Prof. Ben G. Elliot, chairman, mechanical engineering, University of Wisconsin.

Gabay Assists President Of West Coast Company

Sunnyvale, Calif.—Alexander Gabay, until recently director of production for Butwin Sportswear Mfg. Co., St. Paul, Minn., has been appointed assistant to the president of Wooldridge Mfg. Co.

For 20 years before coming to the U. S. during World War II, Mr. Gabay was a plant engineer with International Harvester Co. in Europe. When France fell, he fled the Nazis with only the clothes he was wearing.

At presstime, ASTE National Headquarters has received word of the death of C. B. Cole on July 24.

Mr. Cole owner of the Tool Equipment Co., of Chicago, was a long-time member of ASTE and was a director of the Society for the term 1946-47. In addition, he had served as chairman of the Chicago chapter, 1939-40; as chairman of the National Membership Committee, 1940-41; and as chairman of the National Publicity Committee, 1941-42.

News in Metalworking . .

ENGINEERING EDUCATORS DISCUSS FUTURE OUTLOOK

Warning that the gap between the need for technologists and the sources of supply is widening each year was the reiterated note of engineering educators speaking before the more than 1,800 leading teachers of engineering and science who gathered at Michigan State College for the 59th annual meeting of the American Society for Engineering Education.

According to the organization's newly elected president, Dean S. C. Hollister, there exists currently an unfilled need for 60,000 engineers after the placement of all of this year's graduating class. In 1952 only 26,000 engineers will graduate, and by 1954 the supply will be down to 12,000. The annual peacetime need for engineers is estimated at 30,000, he said.

The situation affects all types of engineering activity, and is intensified by the needs for military research and development. Dr. Eric A. Walker, executive secretary of the Research and Development Board pointed out that Department of Defense work requires nearly half of the nation's research engineers and scientists; and these needs possibly will rise to 65 percent next year.

The urgency of using engineering manpower more efficiently and of extending research jobs and facilities ran through most of the 244 papers presented at the conference. Most of the authorities foresaw no end to the shortage of engineers and scientists. One of the representatives of industry said that his company did not expect to catch up with its demand for engineers until 1964.

Dean A. A. Potter of Purdue University, speaking on the National Science Foundation of which he is a board member, said that the Foundation is undertaking to promote and support basic scientific research in mathematical, physical, medical, biological and engineering sciences. He called for government aid for fundamental scientific and engineering studies, stressing the fact that "basic research, on a scale commensurate with the dominant position of the United States in applied research and invention is essential to protect the industrial and technological competence of our people."

Our industrial supremacy is due largely to the fact that our people have been encouraged to invent, translate their inventions into marketable products, and manufacture those products in quantity, and at a cost to stimulate and satisfy public demand. In the future even more than in the past, our country's welfare will depend upon scientific and technological developments; and these will require people who have ability to create basic scientific knowledge, Dean Potter said.

The Foundation's prime responsibility, he pledged, will be to develop a sound national policy for the promotion of basic research and education in the sciences; and its second task will be to evaluate the need for research in the various scientific fields and to provide emergency support in the directions of greatest need.

COLONIAL STEEL OBSERVES FIFTIETH YEAR

The Colonial Steel Co. of Monaca, Pa., this year celebrates the 50th anniversary of its founding. The company, which now is a division of Vanadium-Alloys Co., specializes in the manufacture of tool and die steels.

Colonial is one of the only four integrated steel companies in the country operating plate and sheet mills for the production of tool steel.

While considered distinctly modern during its early years, electric furnaces exclusively today replace the crucible and open hearth furnaces—and latest installation plans include one of 25,000-lb. capacity.

MILLER MOTOR OPENS PLANT

Modern plant design and layout are features of Miller Motor Company's new cylinder plant at Melrose Park, Ill., a suburb of Chicago.

Although production now has started, a welcoming open house is scheduled for September 15 so visitors may tour the area.

WENDT-SONIS BEGINS EXPANSION PROGRAM

The building program now underway at Wendt-Sonis Co. will approximately double the productive area by adding more than 16,000 square feet of working space. The entire project, including construction and new equipment will amount to over $300,000.

SCIENTIFIC TIME STUDY DISCUSSED AT CONFERENC

Time study, no less than other d sions of professional engineering sho be based on scientific principles. T was the opinion of James H. Dunc managing partner for The Work-Fac Co. and vice-president of Warsaw Pr ucts, Inc., as he spoke recently bef the conference on work simplificat and measurement, conducted in t Frederick Winslow Management La ratory, Wharton School, University Pennsylvania.

Use of these principles can minim time study inconsistencies by provid a tangible yardstick for measuring p ductivity, according to Mr. Duncan, u should indicate how long it shou rather than does, takes a specific ope ator to perform a specific task; elim nate individual judgment, provide time tested and proven basis for a curate and fair wage rates.

In driving home his theory, Mr. Du can pointed out that structural eng neers, though they build in widely sep rated sections of the country, usual arrive at the same results because th all use the same scientific principles a basis for their work. Time study, h emphasized, no less than other enginee ing professions, should be based o scientific principles and as a basis i work measurement.

MEEHANITE METAL SPONSORS CONTEST

The Meehanite Metal Corp. is cu rently conducting a contest open to m gineers and designers in the industry Object of the competition is to secur complete descriptions and illustration of products and equipment which ha been recently designed to incorporat Meehanite castings as component part Cash prizes include a $500 first awar plus five additional ones.

Judges for the contest, which wi close September 1, will be members o the Cincinnati corporation's technic staff.

NATCO MARKS FIFTY YEARS

A half century in industry was th year observed by National Automati Tool Company, largest exclusive manu facturers of multiple spindle drilling machines.

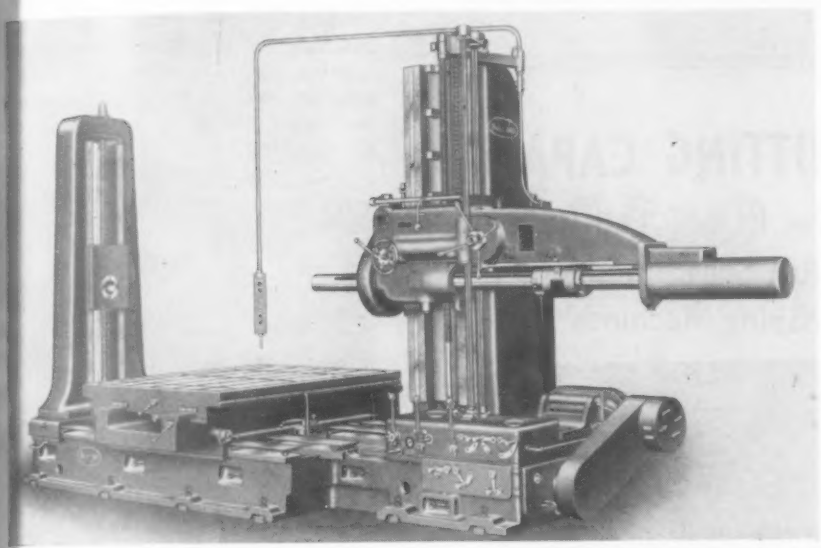
More than 7,000 visitors toured the plant during the two-day open house which marked the celebration.

Tools of Today . . . .

4-Way Horizontal Boring Mill Features Non-metallic Bearing Surfaces

Available in 4 and 5 in. spindle sizes, a 4-way bed horizontal boring, milling and drilling machine, by The Bullard Co., Bridgeport 2, Conn., incorporates modern features conducive to extended useful life and reduced maintenance.

The heavy box-type 4-way bed supports equally an exceptionally heavy, well-ribbed box type saddle and table. Bed ways are covered with stationary sheet metal guards which exclude chips and other foreign matter. Non-metallic bearing surfaces, under both saddle and table, provide long-wearing, replaceable bearing surfaces.



Amony other design features, the saddle guide and feed screw is located between the inner bed ways, thus minimizing cocking tendencies due to uneven load distribution. A single lever self-equalizing clamp, acting on the outside of the bed ways, provide maximum hold-down effect. Table cross feed nuts revolve in pre-loaded anti-friction bearings and are adjustable for wear.

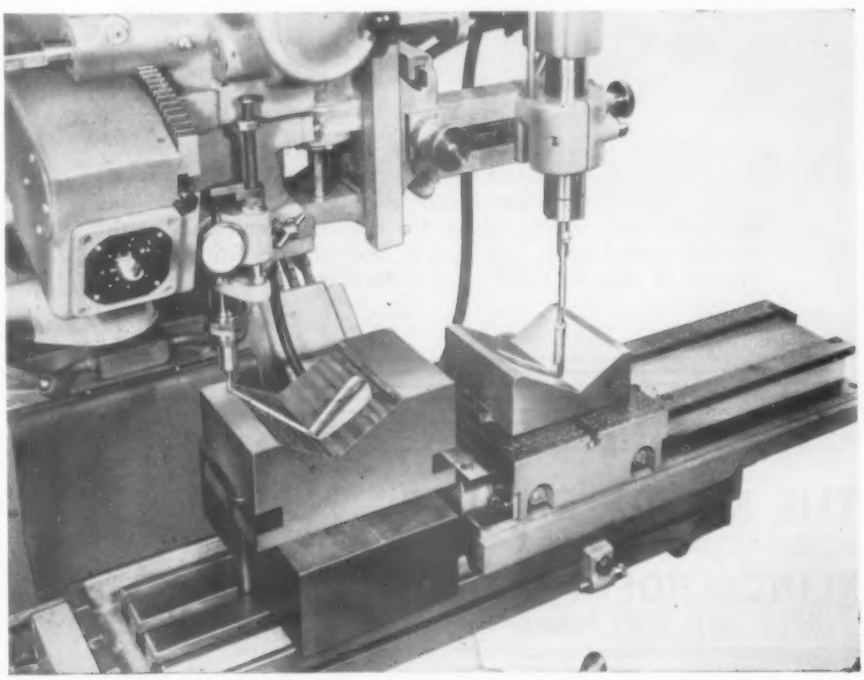
Since a smooth positive drive is essential for horizontal boring machine work, these Bullards are equipped with an improved type hydro-dynamic coupling —fluid drive—and brake motor, driving through multiple V-belts. This type of drive is said to assure smooth, positive acceleration and stop while at the same time, absorbing shocks induced by interrupted cuts. The 4 in. spindle machine has 24-step speed range 8 to 1000 rpm, while the large machine has 24 speeds from 7 to 850 rpm. **T-8-731**

Reverse Image Attachment

A reverse image attachment for their vertical Hydro-Tel type milling machines, announced by The Cincinnati Milling Machine Co., Cincinnati 9, Ohio, is designed for milling right or left-hand dies, molds, and hobs from masters of the opposite hand. As stated by the manufacturer, both right and left-hand matching halves of a die can be milled to perfect symmetry, using only one master. The attachments are available for three Cincinnati milling machines: the 8 x 18 in. tool and die miller; and the 16 and 28 in. vertical Hydro-Tel. The several sizes function in the same manner.

Designed to be mounted on the machine table at the right-hand end, under the vertical depth control unit, the attachment consists of a rigid supporting base which carries an auixilary table on anti-friction rollers. At the rear of the attachment, a pair of matched racks —one on the supporting base and one on the auxiliary table—are engaged by a gear which is carried by a fixed bracket.

The gear acts as an idler between the two racks, translating movement of the machine table to movement of the attachment table in the opposite direction; therefore, a master shape mounted on the auxiliary table will be reproduced in the die block, but to the opposite "hand". **T-8-732**



Redesigned "Insert" Tools

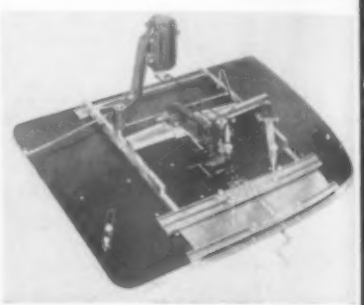
Carbide-insert "Mechanigript" tools, by the Firth Sterling Steel & Carbide Corp., Pittsburgh 30, Pa., have been completely redesigned with the object of eliminating chip erosion of the tool shank. In the previous design, in which the steel shank nearly surrounded the carbide, chip erosion proved serious even though hardened alloy tool steel was used.

The redesigned tools feature open facing of the carbide insert so that the chip curls directly against the carbide. Additional features include top or bottom adjustment of the carbide inserts; thus, the tool mounting may be conventional or inverted while still providing easy access for adjusting the carbide insert. All styles of the redesigned Mechanigript tools take carbide inserts made to carbide industry standards.

T-8-741

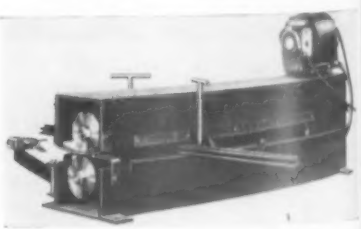
Engravograph by Hermes

An enlarged capacity engraving machine, said to be capable of engraving on units up to 25 in. in width and to any length on metal or plastics is announced by New Hermes, Inc., 131 University Pl., New York 3, N.Y. According to the manufacturer, the machine is particularly suited to engraving names, numbers and instructions on dials, nameplates and panels in range from small areas to larger practical dimensions.



The Engravograph works on the pantograph principle, is portable and capable of engraving 15 different sizes from one template. It can also do multiple engraving in one setup using adjustable copy holding slides. Its simplified construction is said to make it operable by unskilled labor. T-8-742

Portable Metal Slitter



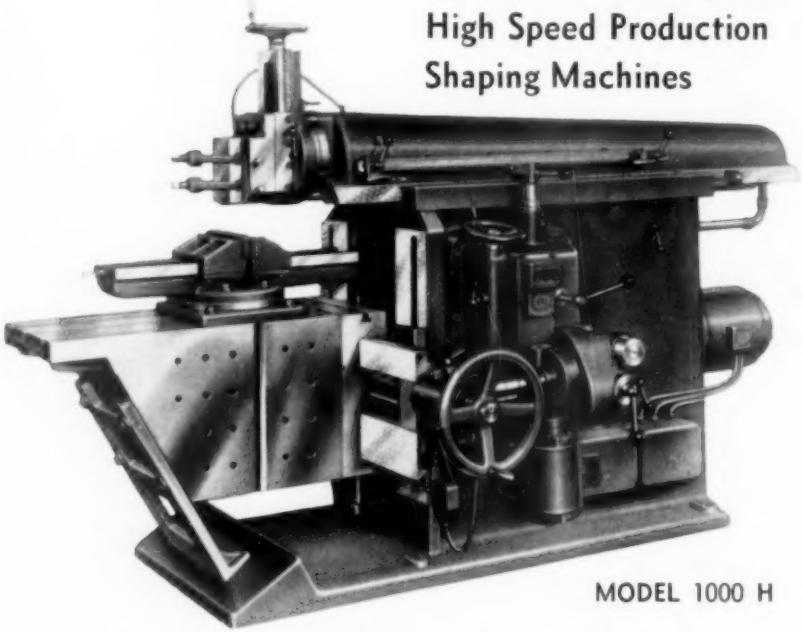
Models 2024 and 1624 metal slitting machines, by the Wilder Mfg. Co., Monterey, Calif., are designed for slitting of sheets up to 20 and 16 ga. in mild steel. Being portable, they also serve for metal slitting work on construction jobs. As stated by the maker, the machine will rip two or more sheets of lighter materials—such as aluminum—at one time, while single thickness strip may be cut at a rate of 100 fpm. A throat depth of 27 in. permits cutting to the center of a 4 ft sheet.

T-8-743

MACHINE TOOLS

FOR UNRIVALLED CUTTING CAPACITY

Use KLOPP Full Hydraulic
High Speed Production
Shaping Machines



MODEL 1000 H

Infinitely variable ram speeds that provide the ***right speed*** for roughing and finishing; a smoothly accelerating return stroke; centralized controls; and—as an extra—an automatic tool lifting device for maximum efficiency with carbide-tipped tools, are but a few of the features embodied in the KLOPP—the shaper that's as modern as tomorrow.

KLOPP

THE KLOPP SHAPER
DISTRIBUTED BY
KLINGELHOFER MACHINE TOOL COMPANY
20 Prospect Street, Westfield, N. J.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-74

Dust Collector

A midget dust collector, the smallest in the line of out-of-doors exhaust type units announced by Aget-Detroit Co., 125 Main St., Ann Arbor, Mich. is especially intended for use where remote-located dust sources have toxic fumes, vapors or obnoxious odors.

While in the bantam class, requiring only 12 x 23 in. floor space, this Model AN20 nevertheless is said to develop a rated 437 cfm and 5000 fpm velocity at the inlet. This amount of suction is adequate to handle a buffing, polishing or grinding wheel up to 10 in. diameter, or two wheels for similar work from 3 to 7 in. diameter. Sanding operations with belt or disc sander on rubber or synthetic are also recommended uses.

The unit is entirely self contained, motive power being a ⅓ hp. 3600 rpm continuous duty motor direct driving a self clearing paddle-wheel type fan. The dust laden air carrying shavings, chips, dust, dirt, along with obnoxious odors and toxic fumes are sent into the cyclone separator. Here, all the material is removed from the air stream except the fumes and the extremely fine dusts, which are exhausted to the out-of-doors through the outlet at the top of the cyclone. Ordinary sheet metal pipe may be used to complete that part of the installation. **T-8-751**

Deep Drawing Compound

Pillsbury Chemicals, 6545 Georgia Ave., Detroit 11, Mich., announces a compound — No. 527 — especially blended for deep drawing of steel in various thicknesses and grades. It is also said to be efficient for drawing of aluminum. Non-pigmented and soluble, the compound can be quickly mixed to any consistency and, as stated by the manufacturer, may be removed with practically any type of cleaner. Further described in company literature.

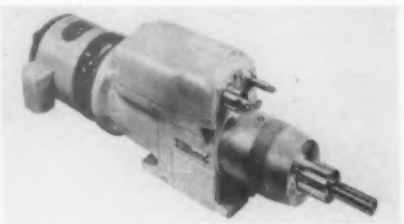
T-8-752

USE READER SERVICE CARD ON PAGE 77 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Hydraulic Drill Unit

Delta Power Tool Div., Rockell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1, Wis., announces the No. 19-400 air-powered hydraulic drill unit. Designed for heavy-duty, high-production work on drilling, tapping, spotfacing and similar operations, the unit will take drills up to ⅝ in. in steel. Because of the sealed construction, it may be mounted in any position.

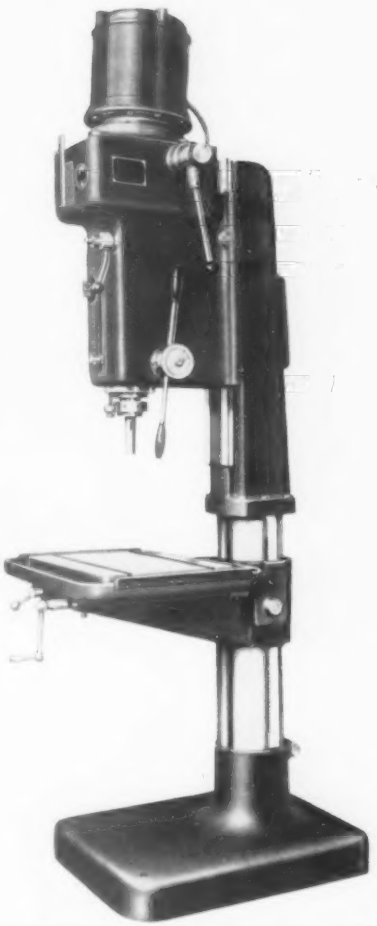
The spindle is driven by electric motors ranging from ¾ to 1½ hp, either directly through a gear train or by V-belts. Plant air supply provides thrust. Feed is infinitely variable from zero to 50 ipm, full stroke 4 in., and spindle returns in one second. The unit may be equipped to feed on the back stroke for threading and back spotfacing. **T-8-753**



MACHINE TOOLS

Varia TRANSMISSION EQUIPPED HIGH SPEED DRILLING MACHINES

Good delivery is available on the internationally known WEBO line of High Speed Drilling Machines. Quality produced by expert craftsmen, these drilling machines can speed your production during the present preparedness period and in the competitive days which are ahead. These modern WEBO heavy duty drill presses are equipped with "Varia" transmissions which permit an infinite variation of spindle speed without pulleys or belts. Easy to set and simple in operation. Safety features are built into WEBO equipment . . . multiple spindles can be furnished . . . depth gauge with dial indicator and automatic release.



Full specifications and illustrations on the WEBO line of drilling machines is yours for the asking. Send your request for information today and state capacities wanted . . . you'll be certain that WEBO is the equipment you need today AND tomorrow!

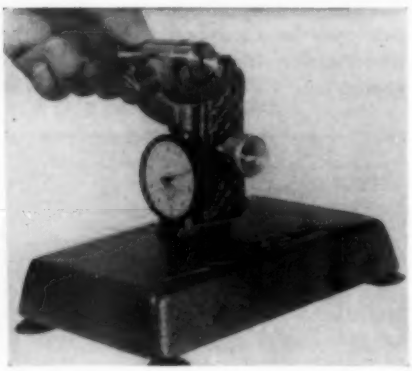
Webo Products:
Supersensitive drills
Power feed drills
Motor spindle drills
Standard and heavy duty radial drills

WEBO
KLINGELHOFER
MACHINE TOOL COMPANY
WESTFIELD, N. J.

KLINGELHOFER MACHINE TOOL CO.
Westfield • New Jersey
Name..... Title.....
Company .....
Address .....
City ..... State.....

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-75

Comparator Gages

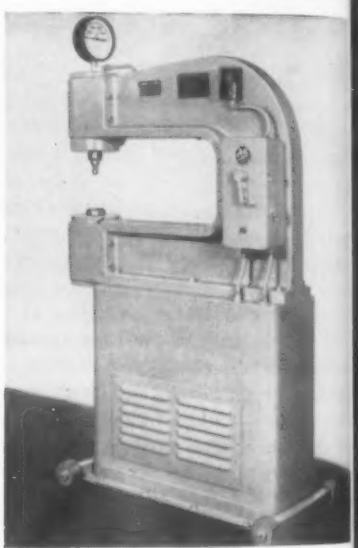


The Troy Precision Tool Co., P.O. Box 52-41, Welshfield, Ohio, announces a line of comparator gages featuring 3-point controlled accuracy and available in a complete line of sizes for a broad scope of diameter inspection operations. Because three strategically located contact points are utilized, the mere rotation of a shaft on the gage automatically effects inspection for out-of-round characteristics or "cloverleaf", common in shaft finishing operations. Accuracy is said to be within 0.000025 in.

Designated Troy Series AO comparator type, these gages are available in a series of 21 sizes covering the ra from 3/8 to 3/4 in. in 3/16 in. increme and from 3/4 in. to 6 in. in increme of 1/4 in. Each gage is adjustable wi in its range and can be set by me of hardened, ground and lapped se ting masters accurate to the desi class of tolerance. Catalog No. 51 gives complete information. T-8-7

Hardness Testing Machin

A Brinell hardness testing machi designed for testing of armor plate, bu readily adaptable to other applicatio requiring a deep-throat tester, is an nounced by Steel City Testing Machi Inc., 8843 Livernois Ave., Detroit Mich. Designated Model AP-1, this hy draulically operated C-frame machi has a throat depth of 24 in. and is de signed to extend over a conveyor. It is mounted on wheels for easy mobili



The lower anvil is the top of a hy draulic piston which rises as the load is applied, to take the pressure off the conveyor. This also tends to keep the armor plate level during test. The max imum vertical opening between ball penetrator and anvil is 4 in.

Operating cycle is controlled by a simple snap switch which is turned "on" to apply the 3000 kilogram load and the "off" to release the load. The diameter of the impression is measured with a Brinell microscope as in all Brinell hardness testing. The hydraulic unit is located in the base which sup ports the C frame. Overall dimensions are approximately 41 in. deep by 19 in. wide; however, machines are made to order so that anvil height will conform to customer's conveyor height. T-8-7

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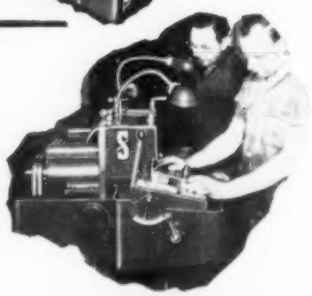
(Right) Mounting a new wheel in 5 minutes!

(Right) Operating view of 10 TD shows ample room to comfortably serve two operators. (Twin lights are optional.) Complete operator comfort when grinding wet. Absolutely no spray or splash.



UNIVERSAL PRECISION PROTRACTOR — TOOL GUIDE with DRESSER grind any size tool for any desired angle.

WRITE FOR BULLETIN TW

THE STANDARD ELECTRICAL TOOL CO.
2499 RIVER ROAD
CINCINNATI 4, OHIO

ALSO:
GRINDERS—ALL KINDS! UP TO 100 H.P. BUFFERS—POLISHERS UP TO 60 H.P.
ABRASIVE BELT MACHINERY. SPECIAL MACHINERY.
TWIN WHEEL TOOL GRINDERS.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-76

THE TOOL ENGINEER'S *Service Bureau*

TRADE LITERATURE CURRENTLY OFFERED BY THE TOOL ENGINEER ADVERTISERS

LITERATURE NUMBER	COMPANY	BULLETIN	DESCRIPTION
A-5135	ADAMAS CARBIDE CORP.		"Carbide Manufacturers' Grade Recommendations" shows grade recommendations of all manufacturers to aid proper selection.
A-5138	AMERICAN BROACH & MACHINE CO.	800	Circular shows complete line of hydraulic surface broaching machines.
A-5120	F. E. ANDERSON OIL CO.		Twenty-page book, "Lusol—the all-chemical Metalworking Solution" presents information on coolant.
A-5128	THE ATRAX CO.		Complete catalog on precision ground-from-the-solid end mills, rotary files, boring bits, reamers, burs.
A-5113	BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE CO.		Informative booklet on cutting costs and speeding production with Robotair.
A-5131	BETHLEHEM STEEL CO	271	Booklet to help in the selection of the right tool steel for hobbed molds, machine-cut molds or master hobs.
A-5140	THE CARPENTER STEEL CO.		Information on "How to Get Better Tool and Die Performance."
A-5124	CHICAGO RIVET & MACHINE CO.		Catalog "Rivets" contains engineering information plus illustrated descriptions.
A-5	THE CINCINNATI SHAPER CO	B-2A	Catalog on Cincinnati press brakes for improving product and reducing costs. L
A-5097-4	THE CLEVELAND TAPPING MACHINE CO.		Catalog of company's line plus "Production Tapping Guide."
A-5139	CRUCIBLE TOOL STEEL CO.		Tool Steel Selector aids in choosing proper steel for particular use.
A-5144	DELTA POWER TOOL DIV. ROCKWELL MFG. CO.		Drill Unit catalog "Air Powered Hydraulic Delta Drill Units helps select size for user's needs.
A-5099	THE DOALL CO.		Catalog explains how cool-grinding works, emphasizing economics.
A-5107	THE DOALL CO.		Twenty-page bulletin on modern measurement control describes gage blocks and accessories.
A-5122-1	THE EASTERN MACHINE SCREW CORP.		Catalogs describe various styles of company's line of die heads, pointing out main features.
A-5109	EASTMAN KODAK CO.		Booklet gives detailed information on Kodak's contour projector and accurate inspection through magnification.
A-5102-4	ERICKSON TOOLS DIV.	D	"Cost-cutting facts" regarding company's air cylinder.
A-5132	GREENLEE BROS. & CO.		Monthly issues of "Automatic News" cover various phases of automatic screw machine production.
A-5133-3	GROBET FILE CO. OF AMERICA, INC.	HC-1	Catalog sheet on Grobet chatterless countersinks.
A-5122	HANNA ENGINEERING WORKS	254	New valve catalog gives features and specifications on complete line.
A-5100	HANNIFIN CORP.	150	"Hy-Power" Hydraulics covers design features.
A-5-3	HARDINGE BROTHERS, INC.	Style "S" Style "B"	Bulletins give performance features, price savings and ordering information.
A-5-2	LANDIS MACHINE CO	F-90	Informational bulletin on applications of the "Ladex" head in high-speed thread production jobs.
A-5-19	THE LAPOINTE MACHINE TOOL CO.	SRV-5	Bulletin discusses features and advantages of Lapointe equipment.
A-5-130-2	MANUFACTURERS ENGINEERING SERVICE, INC.		Catalog covers complete line of drill jigs and milling fixtures.
A-5-126-4	W. F. MEYERS CO., INC.	13	Catalog gives full details on bushings plus price list.
A-5-141	MILLER MOTOR CO.	A-105 a-104	Illustrated bulletins give information on company's lines of cylinders. Also JIC Hydraulic Standards.
A-5-117	NATIONAL BROACH AND MACHINE CO.	49-11	Discusses broaching and broaching problems.
A-5-18	NORTON CO.	1340	Booklet, "Setting-Up Polishing Wheels and Belts," contains helpful polishing tips.
A-5-9	NORTON CO.		Free 140-page booklet "Grinding Carbide Tools" covers problems, applications, etc.
A-5-122-3	OAKITE PRODUCTS, INC.		Illustrated 44-page booklet on metal cleaning.
A-5-84	O'NEIL-IRWIN MFG. CO.		Forty-page "Die-Less Duplicating" catalog covers line of benders, brake, shears, rod parters, notchers, punches.
A-5-133	ORTMAN MILLER MACHINE CO., INC.		Complete set of templates showing all cylinders and mounting brackets.
A-5-93	POTTER & JOHNSON CO.		Booklet, "Productivity with Economy," illustrates examples of precision tooling on P&J Automatics.
A-5-115	ROBERTSON MFG. CO.		"How to Buy Production-Time" contains facts about grinding wheels.
A-5-76	THE STANDARD ELECTRICAL TOOL CO.	TW	Provides extensive information on company's tool grinder.
A-5-11	STANDARD PRESSED STEEL CO.		Reprints of ads presenting specifications for various size socket head cap screws.
A-5-108	STANDARD TOOL CO.		"Tapping Data" provides help on metal cutting problems.
A-5-108-1	SWARTZ TOOL PRODUCTS CO., INC.	941	Catalog describes and illustrates line of single and double action lock clamps.
A-5-108-3	THE VAN KEUREN CO.	34	Catalog and handbook contains 208 pages of data representing two years of research on measuring and gaging.
A-5-92	S. B. WHISTLER & SONS, INC.		Catalog stresses features, advantages of Whistler adjustable dies.

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Holding Tools

Catalog "J", covering line of precision holding tools, includes sections on precision collet chucks, adjustable and full floating holders, precision tap, air-operated speed chucks and air cylinders, precision expanding mandrels, speed indexers and boring and reaming tools. **Erickson Tools, Div. of The Erickson Steel Co.**, 2309 Hamilton Ave., Cleveland 14. L-8-1

Bearings

Catalog 51b gives specifications on more than 70 different types and sizes of miniature ball bearings; illustrations show actual sizes; emphasizes design factors, touching on clearances, tolerances, lubrication and testing; describes and illustrates typical applications, design variations, particular advantages. **Miniature Precision Bearings, Inc.**, Keene, N. H. L-8-2

Carbide Rods, Bushings

Comprehensive Bulletin B-151 contains detailed information for users of tungsten carbide rods and bushings; includes gram weight tables, standard tolerances for unground pieces, extra charges for special forming operations to enable users to estimate prices, determine most economical quantity and shape, determine grinding stock. **Adamas Carbide Corp.**, Harrison, N.J. L-8-3

Grinding

Third printing, brought up to date, of G-503-2, "Principles of Centerless Grinding", discusses basic principles, methods and advantages, wheels, truing, typical examples; also contains pertinent data tables; illustrated by drawings and photographs. **The Cincinnati Milling Machine Co.**, Cincinnati.

Scientific Instruments

Brochure displays company's Balphot Metallograph for speedy determination of crystalline structure, composition, grain-size and non-metallic inclusion content of metals, with complete description of its operation, main features, advantages close-up photos and text stress particular details of equipment. Price lists included. **Bausch & Lomb Optical Co.**, Rochester 2, N. Y. L-8-5

Precision Machining

Precision milling, boring and grinding which can be combined with machine tools or work-holding fixtures for use in production machining or maintenance or experimental shops discussed in Bulletin No. 8; widely illustrated, booklet covers dimensions, specifications, performance data and special features. **Versa-Mil Co.**, 30 Church St., New York 7. L-8-6

Gages, Dimensional Control

Brochure pictures line of mechanical gages for bench and for machine and/or bench checking of parts; descriptions and important features outlined and instructions for installation and removal included. **The Dow Mechanical Corp.**, Thompsonville, Conn. L-8-7

Materials Handling

Comprehensive catalog of line of materials handling equipment includes general description and application data; one section describes various attachments to give industrial trucks versatility; widely illustrated. **Yale & Towne Manufacturing Co.**, Philadelphia Div., 11000 Roosevelt Blvd., Philadelphia 15. L-8-8

Duplicating Attachment

Brochure explains operation of T chan follower, hydraulic duplic attachment for turning, milling, sinking, planing, profiling, sha widely illustrated by photos and d ings; emphasizes simplicity of op tion, accuracy and other advant **Turchan Follower Machine Co.**, Livernois, Detroit 4. L-

Grinders, Cylindrical

Sixteen-page brochure describes pany's No. 2 Race-A-Way oscill cylindrical grinders; pictures the chine and various operations it can form; stresses features of design, op tion, special devices, equipment tooling; includes specifications. **Tool Co.**, Waynesboro, Pa. L-

Punches

Catalog 514 explains compu service which offers more than 000,000 punch sizes and styles; trated, brochure gives dimens prices, ordering information plus d ings showing typical applications, factors affecting best results. **Punch & Die Corp.**, 373 Old Nia Falls Blvd., North Tonawanda, N. L-8-11

Vacuum Calculator

Slide-rule calculator for quick putations of vacuum research and p essing work such as needed capacity to evacuate a given volume a specified vacuum in a given time determining vapor pressures of at various temperatures; pertinent version tables and charts on re side for handy reference. **F. J. Stok Machine Co.**, 5900 Tabor Rd., Phi delphia 20. L-

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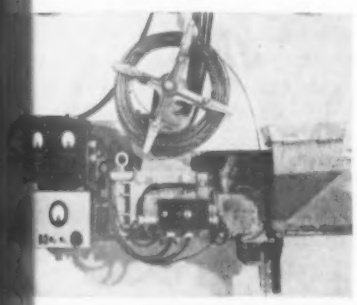
"Unionmelt" Welders

s stated by the maker, uniform ling of straight-line seams in light eavy plate can be done at high ds with the UE-48 welding ma- e announced by Linde Air Products Division of Union Carbide and on Corp., 30 East 42nd St., New k 17, N.Y. Designed for "Union- " welding in permanent produc- installations, the machine consists inde's recent CM-48 side beam car- e, a UE welding head, a small rod a Unionmelt feed hopper, and rols. The equipment is mounted the steel frame of the carriage, h rides a cold-rolled steel track. S "Unionmelt" welding head can be used wtih this carriage, and machine is then designated the 8.



lding conditions for a particular an be set into the control mechan- of the machine before it is put operation; thus, welding current, ge speed, welding voltage, and ial flow all can be adjusted be- welding begins. An electronic gov- control permits a stepless speed of the carriage from 3 to 200 r minute. The rate of speed can e-set by a meter, and the carriage move immediately at that speed started. The speed rate can also hanged while the carriage is in n.

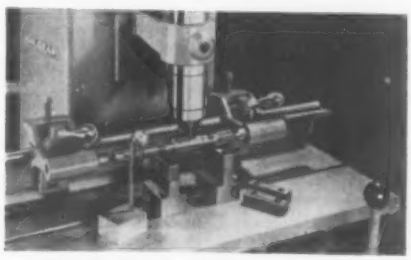
th controls adjusted for a desired ng condition, the operator switch- e machine "on" when it proceeds ld without further attention. This the operator to unload and load elding jig, reduces human error effort, and results in the produc- f identical welds.

e machine is applicable to a wide y of work and is designed to weld from 16-ga. to 1½ in. thick with gle pass. The head can be posi- at right angles to the track, or el to it, and can be adjusted to any type of butt or fillet weld. e reel, holding 150-lb. rod coils, so be used in place of the small nown.

T-8-791

Straightening Press

A 10-ton gooseneck straightening press—Type PGRF, by the Oilgear Co., 1560 W. Pierce St., Milwaukee 4, Wis. —is designed for rapid straightening of small and medium shafts. Among design features, the press incorporates a spring loaded fixture which holds the shaft from the resistance blocks during gaging. The shaft may then be turned to ascertain run-out. A dial indicator is included among accessories.



To operate, the work is loaded on the centers, the spring supports clamped, and the control lever depressed to bring the ram nose down to the work. The lever controls pressure and speed of the ram, its travel and direction, and thus simplifies the straightening of identical workpieces. Press stroke is 18 in., daylight 24 in., and throat 8 in.

T-8-792

"MARVEL" HAS always had the edge

MARVEL High-Speed-Edge Blades assure Faster, more Accurate cutting with proven Economy and complete Safety. Only the MARVEL is a composite blade with a high speed steel cutting edge electrically welded to an exceptionally tough, strong alloy steel body.

The High-Speed-Edge does the cutting while the alloy back with hardened eyes, carries the load. Blade tensions up to 300% higher than those possible with ordinary blades are recommended. This greater tension is confined to the cutting or leading edge by the location of pin holes (exclusive MARVEL design feature) and cannot be overcome by work resistance. Heavier feeds and greater speeds are practical without "run out."

With greater accuracy, higher production and lower cost per cut, come the extra dividend of Safety, for MARVEL High-Speed-Edge Hack Saw Blades are Positively Unbreakable—*they will not shatter.*

Ask your local MARVEL distributor (see classified phone book) to help you modernize your metal sawing with MARVEL High-Speed-Edge Blades. They cost no more than ordinary blades.

1. High-speed-steel cutting edge.

2. Tough unbreakable alloy steel body with hardened eyes.

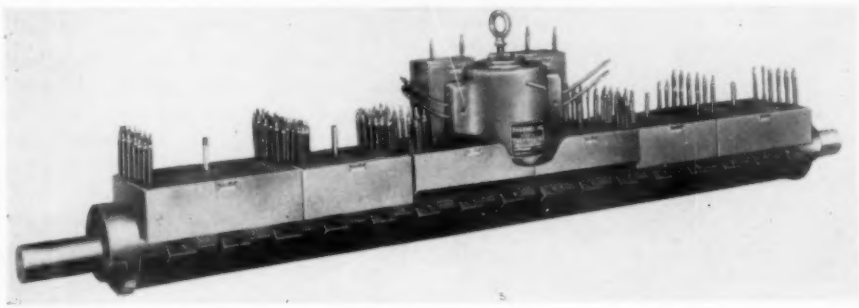
1. & 2. Integrally welded to make a fast-cutting, long lasting composite blade that is *positively unbreakable.*

MARVEL Metal Cutting SAWS
Better Machines—Better Blades
ARMSTRONG-BLUM MFG. CO.
"The Hack Saw People"
5700 Bloomingdale Ave. Chicago 39, U.S.A.

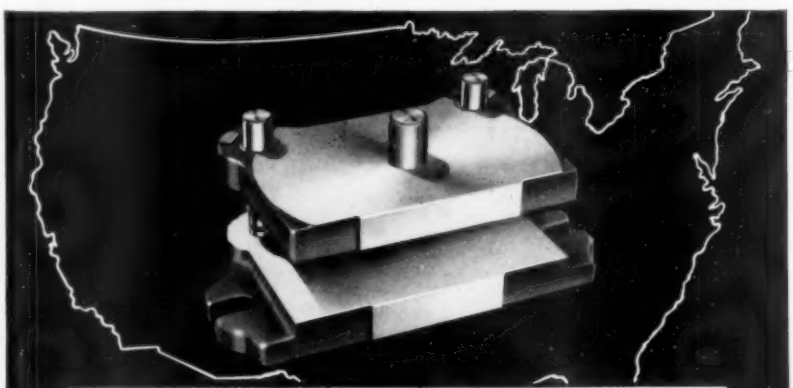
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-79

High-Temp Heaters

Thermel, Inc., 3440 W. Lake St., Chicago 24, Ill., announces their "Thermaheaters", designed to enable a plastic sheeting die, 70 in. in length, to process in excess of three hundred pounds of material per hour at 800 deg F. The assemblage consists of six cast in aluminum-bronze heaters on the die proper and three cast-in aluminum-bronze heaters on the throat assembly between the extruder and die.



The design details of the heaters are such that long life may be expected even at full capacity. This is accomplished by the use of multiple numbers of heating elements of conservative ratings in the castings. This also offers the added advantage that for high production processing of materials such as polyethylene at the conventional temperatures of 500-550 deg F, the multiple number of elements can be connected up to operate on reduced voltage. Complete information on this interesting development may be had from the manufacturer. T-8-801



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DETROIT DIE SET CORPORATION
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DETROIT DIE SET ★

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-80

Truck with Roll Clamp

A rotating roll clamp designed for attachment to fork trucks of 2000-lb capacity is announced by Clark Equipment Co., Industrial Truck Division, Battle Creek, Mich. Heretofore available only for attachment to trucks of 3000 lbs. capacity and up, it is designed to handle rolls of not over 1500 lbs. on "2024" models, and of not over 950 lbs. on "2015" models.

The unit can be rotated through deg so that a roll may be picked from horizontal position and stood end, or vice versa. It is rotated by cylinder with chain and sprocket age, and is provided with positive stop at vertical and horizontal positions eliminate excessive strains on the chain.

Clamping action is largely similar that employed on larger models in the one clamp arm is rigidly mounted and when rotated, is always in bottom position for handling horizontal rolls. The second clamp arm is hydraulically actuated and provides a maximum clamping force of 5000 pounds. The rotating roll clamp is readily removable and can be used interchangeably with standard forks. A bulletin containing full specifications is available on request.

T-8-802

Hydraulic Speed Mill

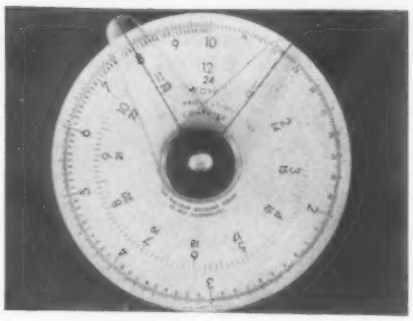
The Viking No. 618 hydraulic "Speed-Mill" is a compact, light production milling machine, designed for fast milling of small parts requiring close limits and fine finish, that features automatic milling cycle, hydraulic feeds, and maximum rigidity for cuts. The machine uses rotary cutters up to 6 in. diameter.

The machine cycles within a range of 10 seconds to 18 minutes, including full table travel. Cycle time varies according to size of cut and length of travel. Hydraulic feed through valve selection is infinite from 3/8 to 24 ipm, over a 7 in. maximum length of cut. A separate 3/4 hp motor assures positive steady power to the spindle, while a standard type 1/2 hp motor drives the hydraulic motor and coolant pump off the one shaft. Coolant is supplied from an 8 gallon reservoir.

The cutter spindle is rigidly supported at the outboard end through a heavy rectangular steel bar overarm and bronze bushing. This construction is said to be unusual for machine in its class—offers rigidity and stability beyond the machine's rated capacity. The 2 in. diameter spindle, mounted in double high-precision grease-sealed timken bearings, has a No. 9 B & S taper for mounting arbors, shanks and adapters. Four spindle speeds—200-375-625-975 rpm—provide flexibility for a variety of cuts, and additional range of speeds up to 3500 rpm is optional at extra cost.

Ample working surface is provided by a 6 x 18 in. table having maximum travel under power of 8 1/2 in. Work is raised and lowered through convenient crank dials. Complete details of this machine may be had from Viking Industries, Dept. C, 220 Montague St., Rockford, Ill. **T-8-881**

Pocket Computer



A short cut to time and motion calculations may be effected with the Loyd Computer, a plastic 4 in. circular disc upon which are concentrically super-imposed a time scale and a log scale. In application, two movable arms integrate the time clock in terms of man hours, unit or aggregate product cost, job efficiency and relative proportions.

Developed and copyrighted by North American Aviation, Inc., the computer is available through Willer Sales Co., P.O. Box 10008, International Airport, Los Angeles 45, Cal. **T-8-882**

Use it for Making:

GAGES

PUNCHES AND DIES

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SPECIAL PARTS

GEARS

Jigs, Templates, Tools *and many other parts*

GREATEST SELECTION AVAILABLE ANYWHERE!

OVER 200 SIZES

1/64" to 1-1/4" Thickness
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CONTROLLED ANALYSIS

PERFECT FINISH

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SEND FOR BULLETINS AND FLAT STOCK CHART SHOWING SIZES AND PRICES.

DoALL precision ground flat stock eliminates costly machining of stock to size, assures you accuracy, fine finish and no shrinkage. Select the sizes you need and you are ready for layout work. *Call DoALL* today.

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Power-Factor Meter

A hook-on power-factor meter which permits direct measurement of power factor, without cutting conductors or interrupting electrical service, is announced by the General Electric Company's Meter and Instrument Divisions.

This type AK-3 power-factor meter may be used on any balanced 3-phase circuit to give direct power-factor readings in circuits with voltages ranging from 100 to 600 volts and currents from 15 to 600 amperes. Small, light, and portable, it can be used to readily locate circuits where corrective action is needed.

To operate, it is only necessary to clip the voltage leads to the potential source, clamp the hook around the conductor, and rotate the selector dial to obtain the proper power-factor reading. The meter, which has a frequency range of 50 to 90 cycles and an effective scale length of 13.5 in., gives readings accurate to within 0.50 power-factor. T-8-821

Torque Indicating Drive

The Garvin Torque-Indicating Driver, by Tru-Circle Products Co., P.O. Box 536, South Bend, Ind., is designed to positively and automatically measure torque while driving studs, nuts, screws or fasteners. Said to provide a precise torque measurement, the driver reduces stud breakage and scrap loss.

The Garvin driver is built around a standard deflection-type torque wrench. In operation, the minimum torque is indicated by the wrench and by a green light, with maximum torque indicated by the same wrench and a red light. Both lights and the torque scale are on the front of the unit for easy reading by the operator.

The unit can be furnished with a relay that interrupts the power source and automatically stops the rotation when the desired maximum torque is reached. Adjustments for both high and low torque limits are quickly made by two screws, using the torque wrench as an accurate gage.

The driver is made in 0-100, 0-350, 0-500, 0-750, 0-1500 and 0-2000 inch-pound capacities. Electric, high-cycle or air motors can be specified. The 0-100 inch-pound model is portable. The larger units are mounted on radial drill press type arms. T-8-8

6 SPINDLE
4 SPINDLE
GREENLEE
AUTOMATICS
Maximum economy of operation on long-run jobs, with an uncluttered, easily-reached tooling area that allows rapid and accurate positioning of tools and attachments . . . permitting precise inspection of work finish and tolerances on the machine. The Greenlee "Six" is available in 1", 1-5/8", and 2" capacity — the "Four" in 1-5/8" and 2-5/8" capacity.
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Minneapolis 3, Minnesota

CINROCK MACHINERY, INC.
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HEPWORTH MACHINE TOOL COMPANY
2311-17 North Sixteenth Street
Philadelphia 32, Pennsylvania

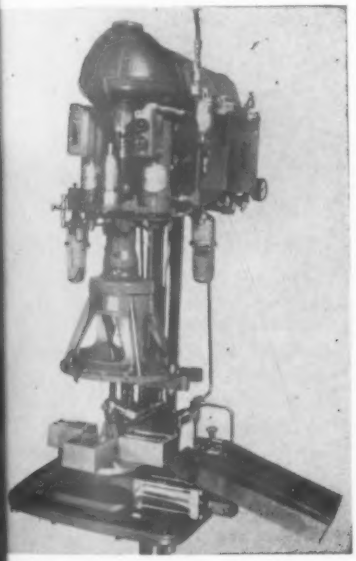
DAWSON MACHINERY COMPANY
5700-4 First Avenue, South
Seattle 8, Washington

FOR FURTHER INFORMATION, USE READER SERVICE CARD: INDICATE A-8-82

Air-Controlled Tappers

High-production tapping and drilling machines which can be equipped with automatic, air-controlled multi-spindle heads and index tables are announced by the Beckett-Harcum Co., Wilmington, Ohio. As claimed by the maker, these machines permit multiple tapping direct from a multiple drill head without lead screws or clutches. Light air pressure permits the taps to provide their own lead, and threads produced are said to be exact duplicates of the taps used.

Multiple tapping is accomplished with a special high-reversal motor designed for a complete cycle every 3 seconds. On motor reverse, taps are said to lead out without stripping the last thread, even in extruded holes on soft metals. By switching out the motor reversing control, drilling operations may be performed and the fixtures used for tapping by removing the drill bushings.

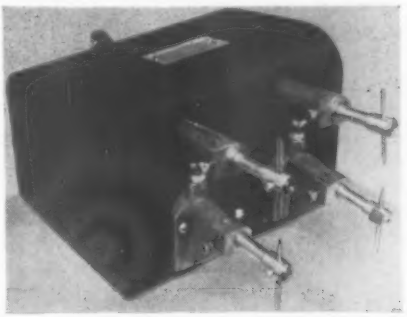


Speed of both the forward and return spindle stroke is infinitely variable and a hydraulic break-through cushion is provided for controlling break-through in drilling uneven surfaces. In a drilling operation, any desired air pressure can be obtained up to 1250 pounds, using a 100-lb. air line. Various types of shuffleboard work feeders or index tables can be supplied, the latter being electrically inter-locked with the spindle stroke so that the work cannot index until spindle is in full position. Nor can the spindle descend until the work table has indexed to proper position. **T-8-831**

USE READER SERVICE CARD ON PAGE 97 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Bench Welding Head

Federal Tool Engineering Co., 532 Mulberry St., Newark, N.J., has added a double-head bench welder to its small-parts welding apparatus. This unit incorporates the "Tweezer-Weld" action which is said to permit automatic welding of small parts at speeds up to 3600 welds per hour.



Pressure is applied through a cam acting against variable deflection of a cantilever spring, arranged to provide instant follow through pressure. Electrode pressure is variable from 6 oz. to 15 lbs. by micrometer adjustments. The unit is furnished with independent switches and treads for each pair of electrodes. It is also available in single head. **T-8-832**

At CIRCLE Ⓡ Quality Makes Progress

Over the years Circle Ⓡ Metal Cutting Tools have established a quality reputation unexcelled anywhere! Circle Ⓡ is expanding its plant for the sole purpose of ensuring the maintenance of these high quality standards . . . a decision which will give you still higher quality and the most efficient and economical circular cutting tools available.

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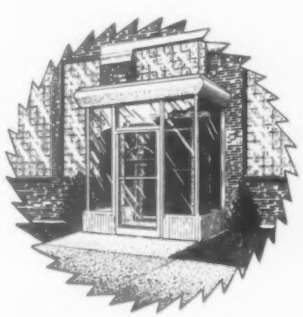
Burbank • Milwaukee • New York City
Indianapolis • Pittsburgh • Philadelphia
Phoenix • Providence • Rochester • St. Louis



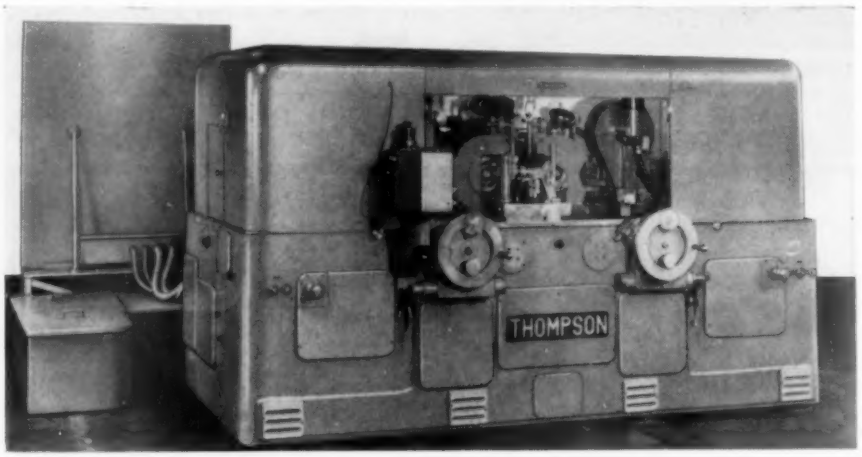
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-83

Double Wheel Bucket and Blade Grinder

Automatic contour grinding with two wheels simultaneously and dressing from a single crusher roll, to assure perfect symmetry in machining turbine buckets, is claimed for the automatic double wheel Truforming Machine recently developed by the Thompson Grinder Co., Springfield, Ohio.

This machine—here shown—is said to provide the highest degree of accuracy and productivity, as well as economy of operation. A typical application is the grinding of both sides of a turbine bucket, of "pine tree" design, approximately 2 in. long, with 0.150 in. stock removal per side from the rough to the finished size.

For such application, production rate is stated at 30 buckets per hour, this said to include down time for dressing, regrinding the crusher roll, machine warm-up, wheel changing and other incidental work. The actual grinding of one bucket is said to be 110 seconds.



Because of various methods of operation, and varying applications, we can only cover essentials in a brief introduction such as the foregoing. In view of the potential economies effected by the machine, however, readers interested in manufacture of turbine buckets are advised to write the manufacturer for detailed information.

T-8-841

Novel Stock Reel

A horizontal stock reel which requires no power and which materially reduces time loss due to strip stock feed interruptions is announced by Jaco Devices, Inc., 102 High St., Hingham, Mass.

To overcome the snatching action of coiled stock eccentricity common to conventional, vertical-type reels, the Jaco reel permits the stock to uncoil from a horizontal position on a ball-bearing mounted turntable. The freely rotating reel is propelled by the natural spring of the material, which develops torque as it uncoils. To accomplish this, the end of the strip material is taken from the center of the coil, passed through a guide frame and over a support to the automatic feed of the press.

The loop thus formed is shortened as the feed draws the stock from the coil until the inherent spring in the material is sufficient to overcome the inertial of the platen and its load. Should reel speed exceed rate of feed demand the coiled material will retard the motion by internal brake action of the center of the coil, thus maintaining automatically the feed requirement of press tool. Since there can be no tightening of the material as it is being fed, snatching cannot occur. T-8-842

USE READER SERVICE CARD ON PAGE 77 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

New di-acro POWERSHEAR

OFFERS
CONTINUOUS ACTION
plus
VARIABLE SPEED
from 30 to 200 strokes per minute

for high speed DIE-LESS DUPLICATING

The new Di-Acro POWERSHEAR has remarkable speed and accuracy for the production of small parts.

1. CONTINUOUS SHEARING ACTION— no clutch to engage! Feeding speed determines shearing speed.
2. VARIABLE SPEED — cycle quickly set for each shearing operation.
3. EASE OF OPERATION — fatigue is reduced, production soars.
4. "SINGLE STROKE" SHEARING — non-repeating safety clutch for jobs not adaptable to continuous shearing.

Any plant doing high speed precision shearing on smaller parts cannot afford to be without the DI-ACRO POWERSHEAR. Available in 12" and 24" shearing widths, capacity 16 gauge sheet steel. Also standard model.

DOES PRECISION WORK ON ALL SHEARABLE MATERIALS

MICA	LEATHER	ALUMINUM	STAINLESS STEEL
PLASTICS	SILVER	SILICON STEEL	and Many
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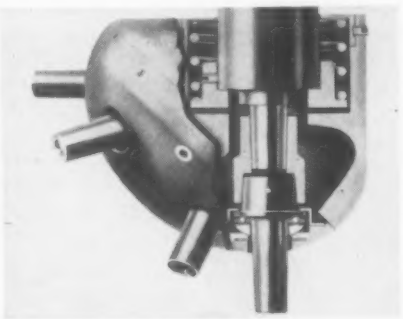
WRITE FOR CATALOG

INDICATE A-8-851

Drill Press Turret

Redesign features of the Lign-o-matic drill press turret, by Howe and Fant, Inc., 531 Flaxhill Rd., So. Norwalk, Conn., include unique bearings which, in connection with other changes, are said to have reduced overall runout to less than 0.0001 in.



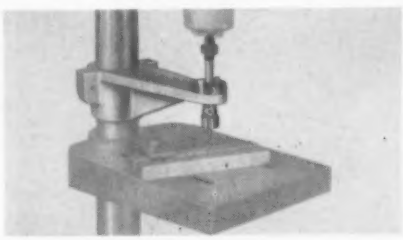
The bearings permit the spindles to move laterally and angularly, as well as to rotate. When the drilling spindle is lowered, the tapered surface of a driver engages the mating tapered surface of a turret spindle. The turret spindle then aligns with the machine spindle, when it locks into position and remains in alignment during drilling.

The turret is designed to fit any standard drilling machine without alteration, and will take six tools for drilling, reaming, counterboring and—on reversible spindle machines—tapping up to ½ in. diameter. Fully described in company bulletin No. 5010.

T-8-851

Tapping Attachment

The "Lead Screw Tapping Attachment" as it has been named, is said to permit production tapping without damage to threads.



The attachment consists of a support arm with clamp; a lead screw, split nut with mounting screws, a lock assembly, a Jacobs "Rubberflex" collet, and nut. The split nut and lead screw are interchangeable for different threads.

The assembly is currently available as a support arm attachable to any standard 14 or 15 in. drill press having a 2¾ in. column. Lead screws and nuts are stocked in pitches 20-24-28-32; 36-40-44-48; 56-64; 72-80. Complete details may be had from Automatic Methods, Inc., 42 Walnut St., Room 279, Newark 1, N.J.

T-8-852

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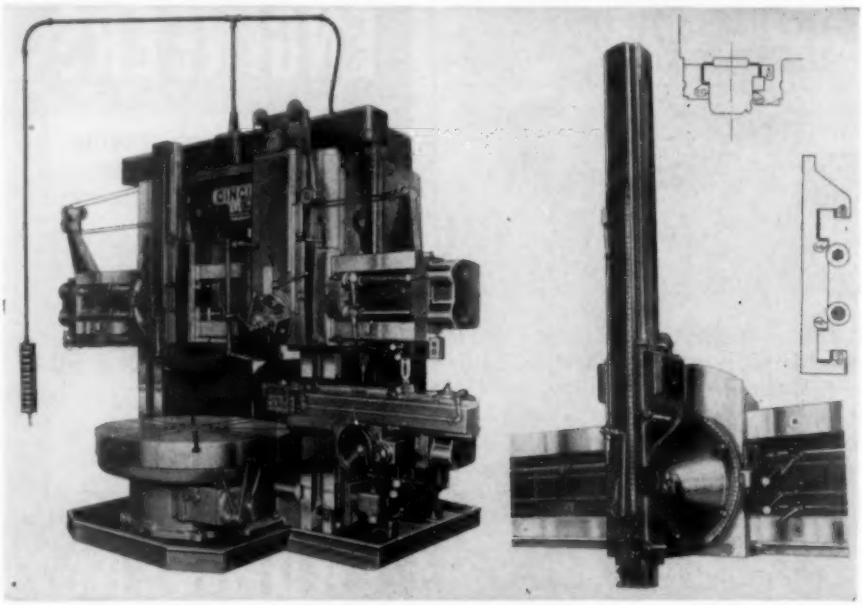
INQUIRIES PROMPTLY ANSWERED

INDICATE A-8-852

Hypro Mills Feature Improvements

Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., announce a combination of important design improvements in their Hypro vertical boring and turning mills.

These built-in structural features include: non-metallic bearings for ram and saddle; independent traverse motors for rail and side heads; swivel type pendant control; helical rack and pinion on the ram; clearly marked feed controls; anti-friction bearing table transmission; new 16 feed gear box; table anti-friction thrust and load bearings; two arrangements of mechanical change gear drives; and three electrical arrangements for single shift drives.



Taking these in order listed, we without going into detailed description which may be had from the builder, the first implies a bearing arrangement designed to insure precision operation under severe service. For one thing, the non-metallic bearings are said to be unaffected by transfer and residual heat which often disort solid metal bearings.

Independent motors provide independent direct drive to machine heads and further reduces the number of vital machine parts subject to wear and maintenance. The pendant control—No. 3 in order—swivels to advantageous work positions, thereby enabling the operator to watch his work with safety and control of the machine. In turn, the helical rack and pinion assures a smoother ram feed.

Clearly marked and conveniently arranged feed controls provide any combination of head feed movements, with quick selection, while the full anti-friction bearing table transmission—No. 6—assures the transmittal of maximum available horsepower to the tool point. Gear changeover further simplifies special machining operations such as drum scoring, taper turning and thread cutting.

Item 8—anit-friction thrust and load bearings—provide higher table speeds for vertical machines which, in turn, makes it practical to use carbide tools to full advantage. Machine functions are further simplified by the Hypro mechanical change gear drives, while three different electrical arrangements provide infinitely variable table speeds. Further information may be had directly from the Giddings & Lewis Machine Tool Co. T-8-86

Tool Grinding Attachment

The AccrAngle grinder attachment, by Carl Nomann Co., 3537 Greenwood Ave., Los Angeles 22, Calif., is designed to permit grinding of single-point turning tools at any angle and on any side without removing them from the holder. T-8-87

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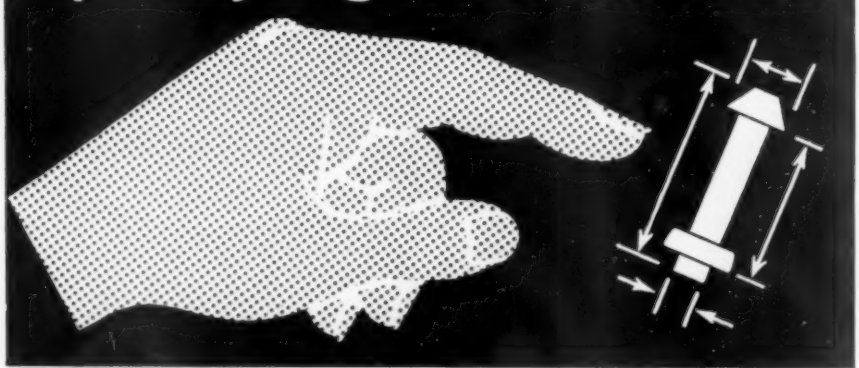

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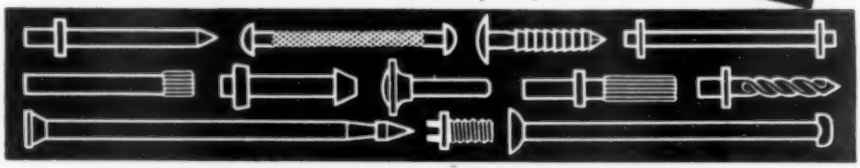

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-86

North East West South IN INDUSTRY

The board of directors of **Monsanto Chemical Co.** recently elected **J. L. Christian** a vice-president of the company. Mr. Christian has been general manager of the company's Phosphate Div. since October, 1948.

George A. Ingalls, a director and comptroller of **American Machine and Foundry Co.,** has been elected a vice-president. Mr. Ingalls is a member of the board of directors of several AMF subsidiaries including DeWalt Inc. and Union Machinery and Transducer Corp. He also is a vice-president of Union Machinery and comptroller of AMF affiliate, International Cigar Machinery Co.

Eugene M. Lang has been elected to the position of vice-president in charge of manufacturing for the **Heli-Coil Corp.** Mr. Lang, who has served the firm in various executive and production capacities since 1941, was formerly works manager at the Heli-Coil plant. **Louis K. Rimer,** former vice-president in charge of operations of Elgin American Co., succeeds Mr. Lang as works manager, and has been elected assistant secretary of the corporation.

Ralph M. Johnson

Eugene M. Lang

Ralph M. Johnson, vice president in charge of sales for **Norton Co.,** recently was elected president of the **American Supply and Machinery Manufacturers Assoc.** at that organization's convention in San Francisco. Mr. Johnson has been active in the association for five years, and has served successively as second and first vice-president.

Lawrence E. Moore, controller of **Vanadium-Alloys Steel Co.,** has been elected a director of the Pittsburgh Control of the Controllers Institute of America.

C. F. Myers has been named vice-president and sales manager of the **Morse Twist Drill & Machine Co.** Mr. Myers formerly was sales manager.

Executive changes made recently at the Boston Works of **Allis-Chalmers Manufacturing Co.** include the appointment of **Leonard J. Linde** as assistant general manager and chief engineer; **Henry P. Pinkham** as assistant chief engineer; **John F. Chipman** as product engineer; and **Chester D. Ainsworth** as standards engineer.

Before his appointment, Mr. Linde was retained by contract as a consulting engineer for Boston Works.

David C. Prince, a vice-president of the **General Electric Co.** on the president's staff and formerly head of the company's general engineering and consulting laboratory, has retired after 32 years of service. Responsible for many developments in the electrical engineering field, Mr. Prince holds a total of 98 U.S. patents and was the recipient in 1940 of the Modern Pioneer Award for outstanding contributions to engineering science.

E. W. Ristau has been named general manager of the **Ohlen-Bishop Manufacturing Co.,** recently acquired subsidiary of the **Rockwell Manufacturing Co.** Mr. Ristau, who has had a long career in the tool field, has formerly been associated with Skilsaw, Inc., Black & Decker, Aristo Power Tools and Cummins Portable Tools Div.

Eugene P. Cunningham

E. W. Ristau

Clearing Machine Corp. have announced the appointment of **Eugene P. Cunningham,** formerly of its Detroit office, as sales manager, succeeding **M. E. Peterson,** who will take over management of the Clearing operations in Joliet, Ill., where a new plant is to be built.

Two staff appointments at the Philadelphia Div., **Yale & Towne Manufacturing Co.,** included the appointment of **Norman R. Amberg** as assistant works manager and **Harvey W. Wesenberg,** supervisor of materials handling.

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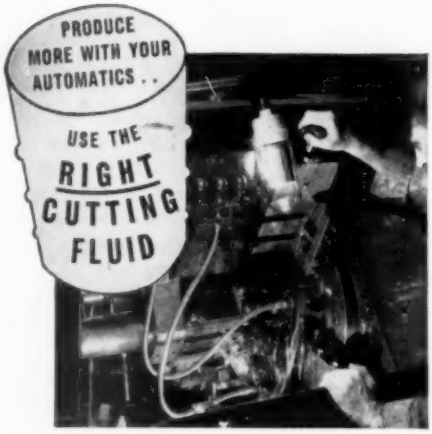

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INDICATE A-2-88

Abstracts of

Foreign Technical Literature

By M. Kronenberg

Great Britain: Britain's defense program depends to a large extent on the increase in productive capacity of industry and particularly on material supply, machines and tools, power supply, labor and production techniques. D. F. Galloway, in an article published in *The Engineer* of May 18, points out that costly experience has taught British industry in two wars that it is essential to take action before the real emergency exists.

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The author presents results of cutting tests for the flank wear of tools as an example for selection of the best feeds and speeds when machining new materials and indicates in numerous diagrams what effect the cutting speed has on the surface finish. In the case of British materials 4 S 1 and En 26 it was found that the poorest surface finish was obtained when using a cutting speed of 200 ft/min and 100 ft/min respectively, while, on the other hand, the best surface finish was obtained at 100 ft/min in the case of "Nimonic 80" material.

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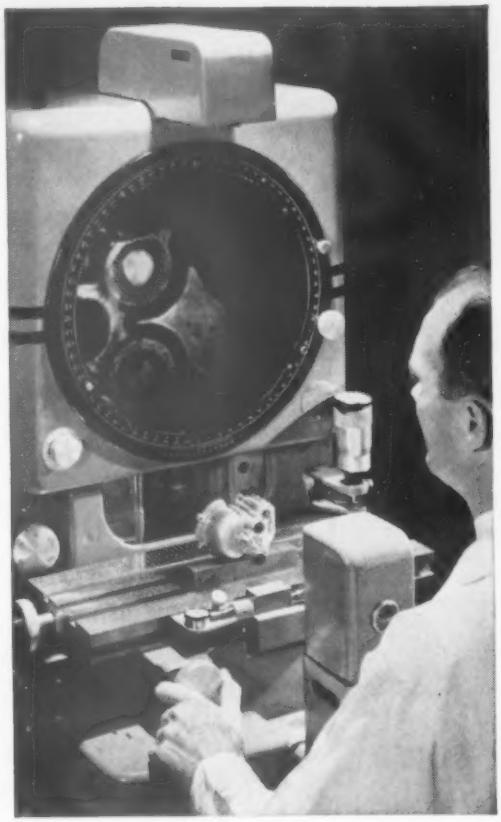

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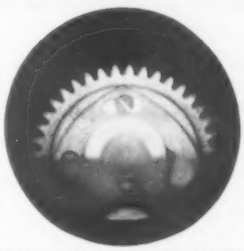

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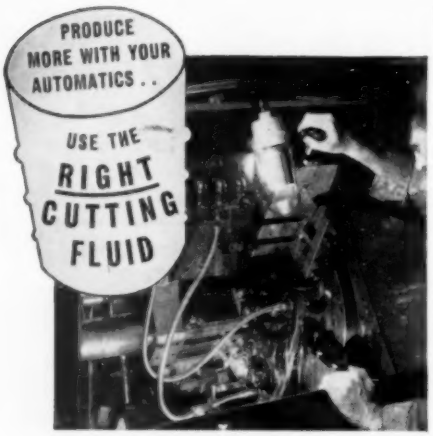

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An investigation on the deep drawing of hollow bodies from heavy steel sheets has been carried out by U. Bander according to his report in Stahl und Eisen of May 10. He included deep drawing of cups and determined and verified some of the factors affecting deformation as well as stress. In addition he studied stretch drawing techniques for double and multiple draws.

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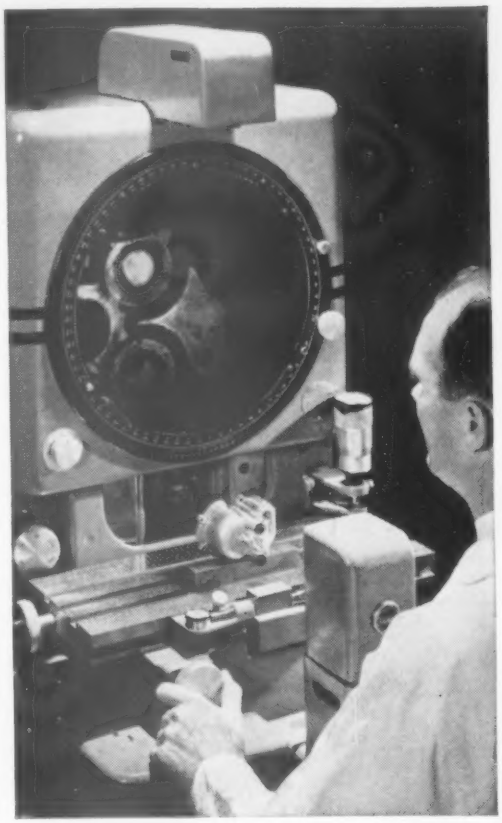

DEEP RECESSES ▶

SURFACE DETAILS

CONTOURS

Few objects are too small or complicated for *complete* inspection under magnification with the Kodak Contour Projector. Deep recesses and surface details, *illuminated from the projection system itself,* stand out sharply and in natural color.

With unmatched versatility, it can be switched instantly from surface illumination to silhouette projection, or a combination of both. Any of six magnifications from 10× to 100× is available at the turn of a dial *without refocusing.* Your operator can work rapidly and efficiently, unhampered by the usual hoods or curtains.

Large parts? Sure! With a full 8″ between lens and object and 6¾″ from object to lamphouse at *all magnifications,* there's plenty of room. The lamphouse pivots to accommodate long parts. And the stage has 4″ of easy, precise travel, vertically and horizontally.

If you have an inspection or measuring problem where speed, accuracy, and convenience are important, it will pay you to investigate the Kodak Contour Projector. The coupon below will bring you a new booklet giving detailed information.

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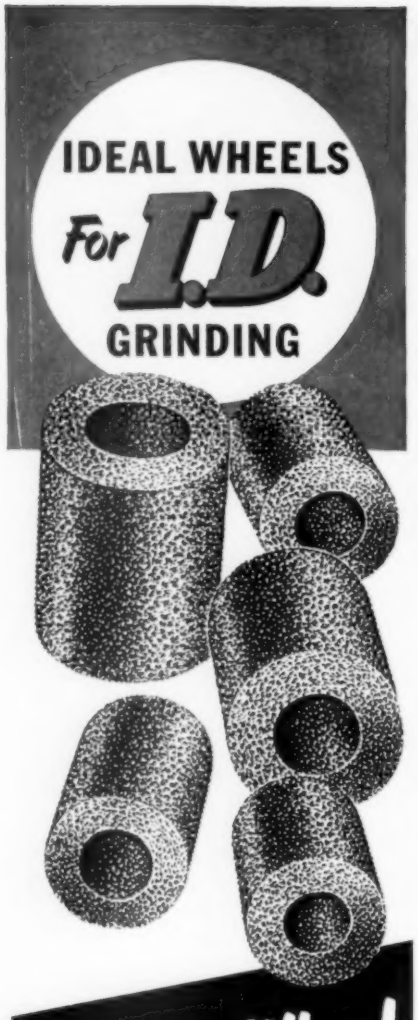

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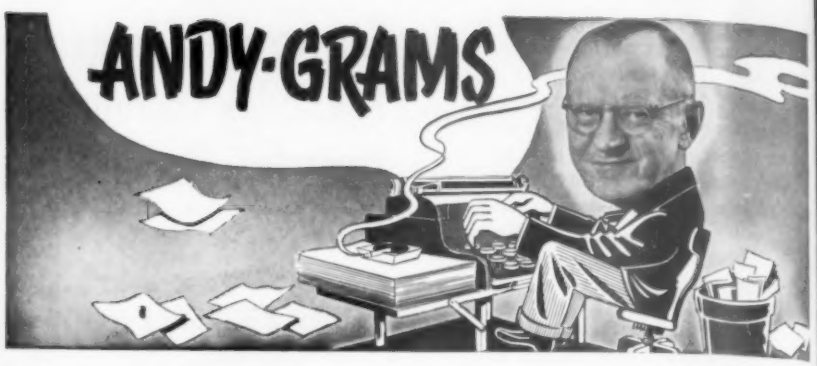


As intimated in July issue, I'm pulling up stakes and moving to California. No, I'm not retiring; rather, look forward with considerable eagerness to years of activity with—I hope—continued promotion of the ASTE. Old soldiers may fade away, but tool engineers retain their lustre to the end.

At that, I've been in harness ever since joining the Society—they put me to work before the ink was dry on my application—and, what with 17 years continuous writing for *The Tool Engineer*, I've probably earned time out for a bit o' play. Take those 17 ft. long worms they have in Australia, now; they grub and grub but finally turn noses up to the sun. Well, that's me; so, as a start toward my second million (the first was too hard to get) I'll maybe pan me some gold in "them thar hills" along with writing a book or two. Anyway, I won't be idle.

Incidentally, I'm not singing my swan song—at least, not in this issue. Consequently, I'll defer that funny story I promised before appending the final "30" to my page, the while giving you an account of my trip and impressions of the Golden West. Anyway, I'm not in a particularly facetious mood at the moment, there being too many pleasant memories associated with ASTEers North, East, West, South. So, we'll talk about the ASTE.

In this connection, I wonder how many of our members have given thought to the fact that, large as it is, the ASTE is still the lowest in annual dues assessment of any contemporary technical society. And that potential returns on investment may by far exceed the nominal $10.00 yearly dues—which, incidentally, includes subscription to *The Tool Engineer*. In many instances, information given on manufacturing techniques alone has been worth enough to net the recipients their membership for life. And that is only a part of ASTE service to members.

Of course, we didn't arrive at our present status overnight; rather, the ASTE of today is the result of untiring work on the part of Society officers and committee workers—and, it may be added, of unswerving loyalty on the part of our members. And minor as my role has been, I'm nevertheless proud to have been a part in building the Society, nor grudge a moment spent toward its promotion. As the Good Book puts it: ". . . those who give their lives shall have it.", and I have reward in the satisfaction of having done my bit toward ASTE progress.

At that, I've poignant memories of the "first hundred years"; recall the early struggles for recognition, let alone survival. There was, for instance, the fateful meeting of Directors in the fall of '37 when, in rented quarters and with only a few hundred dollars in the treasury, we staked the very existence of the Society on a $100,000 venture—the first ASTE Tool Show, held in Detroit the following spring. And we made it!—and from then on the Society grew and grew. Today, we own our own home, a beautiful building that is the pride of the entire membership. That's progress!

I recall when we first branched out as a national order, with me as secretary and general doubler-in-brass for Detroit chapter, since listed as No. 1. Otto Winter was chairman, but pulled out to start Toledo chapter; Slim McClellan—whose shadow has never grown the lesser—was program and entertainment chairman; and Bill Smila treasurer. Nice boys to work with.

We started the year broke but wound up in the black—and that barely—although, when my term was up, I found my accounts short by $25.00. Thanks to Bill Smila, who'd kept the receipts, I was saved making the amount good. At that, I've no scruples about taking Bill's shirt—if and when I can get it. Bill plays 'em close to the vest.

Personally, I've enjoyed my affiliation with Detroit chapter and look forward to equally pleasant associations in Golden Gate chapter, to which I'm transferring. But east or west, I'll be in touch with *auld acquaintance* as long the ASTE News remains in the capable hands of Doris Pratt, who—at moment of writing—is gracing the head table at a new ASTE chapter being chartered in London, Ontario. Skoal to the Canadians!

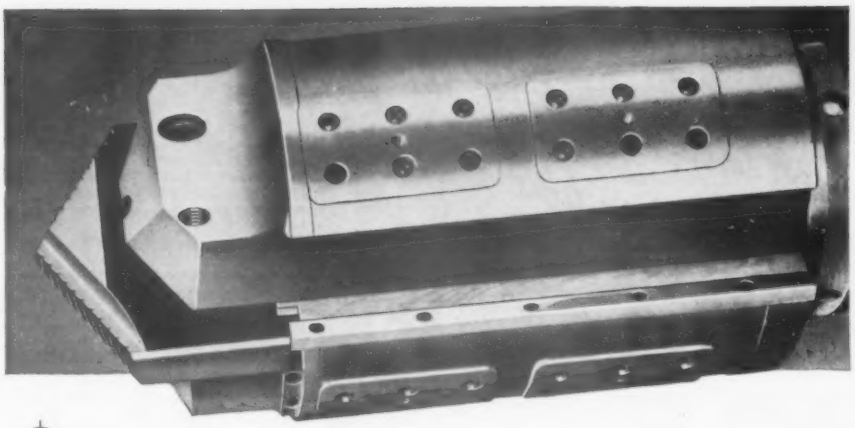
Now that I'm leaving and can't very well be accused of apple polishing, I want to pay deserved tribute to my fellow workers at Society H.Q.; especially to Harry Conrad, our executive sec'y. Sure, we've had occasional differences of opinion—you know me for a stubborn Swede—but out of those differences has grown a sense of values. For the record, then, and bearing out what I wrote in 1945, I reiterate my belief that Harry is not only doing a good job but is working 100 percent for the ASTE. The same goes for Jack Eacock, office manager, and his fellow workers in what we have come to term the front office.

Naturally, my heart is with *The Tool Engineer*, and I want to see our official publication grow and prosper. To that end, my best wishes to the young blood that's taken over. May they grow in stature commensurate with their responsibilities and project *The Tool Engineer* to new heights. And to Clarence Etter, advertising manager and warm friend, and to his field managers, my best wishes in selling our magazine to industry. Ours is a good publication and an excellent medium for advertising. Personally, I'd like to see more of my friends in the advertising pages.

Well, I've a lot of loose ends to gather up before leaving, and time is getting short; in retrospect, has flown on golden wings. There's mail to answer—if I can get around to it all—and material to bank for publication, property to settle and preparations made for the trip. You just don't pull up lock, stock and barrel and uproot yourself—like that! —after nearly 30 years residence in a locality. So, I'll leave you for now—and happy landings! Will see you in California.

ASTEely yours

Andy



DEEP HOLE TOOLING

Maybe your product calls for a ten-inch hole. That's a *large* hole. Or maybe it's just three inches, but five feet deep . . . that's both a *large* hole and a *deep* hole. Or a 3/16 hole, running the length of a rifle barrel . . . not large, but very *deep*.

Those are difficult holes to drill; from the solid that is, in one continuous operation . . . especially in today's tough and hard alloys, heat-treated before machining.

Indeed, the difficulties in what we generally call "deep hole drilling" increase three ways: with the diameter, with the depth, and with the hardness of the material.

Drilling and boring holes like these requires specialized engineering, including the selection of the right machines and equipment, and tool design backed by long experience.

This experience is not just under our hats. It's on paper, in carefully kept records, and it's in glass jars, containing our collection of chips.

We keep our eyes on those chips, because we know that every tool we design must produce chips of carefully determined size and shape, so they can be flushed out of the hole without interruption.

Ample flow of coolant must be provided through the inside and along the outside of the tool to carry off the chips, yet, the necessarily long tool body must be strong enough to prevent torsional deflection which might cause chatter.

To strike the fine balance between these various factors has been daily work at CONNER's for so long, that CONNER tool designs never fail to give calculated results, providing they're put to work as recommended.

So, if your products call for deep holes, come to us. We don't know what your problem may be, but, in most cases, we have been able to provide tools of such design that the first pieces produced passed inspection.

CONNER also offers its services:
- **as Consultants, to devise production methods**
- **as Toolmakers, to supply standard and special tools**
- **as Drillers, to do deep hole work for you.**

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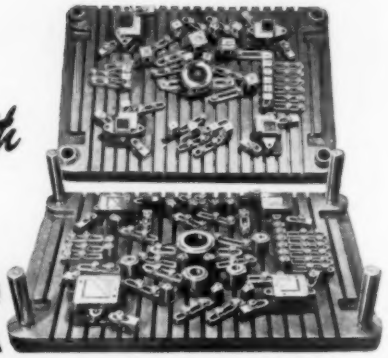
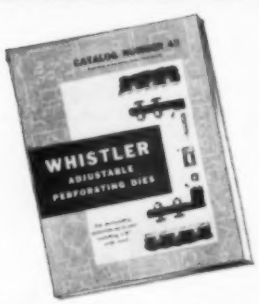


WHISTLER ADJUSTABLE DIES



There are plenty of other advantages in using Whistler Adjustable Dies. It makes sense to get the complete story. And it's easy to do. Write for your Whistler Catalog today.

Whistler perforating dies now offer a double-barreled advantage in getting into production faster. Standard sizes of round hole punches and dies... 1/32 to 3"... can be shipped promptly. Special shapes...squares, ovals, rectangles, group and notching dies, are quickly made to order.

Equally important, set-ups are simple...take only a short time. Same units can be rearranged or units added in setting up different jobs. Production is thus speeded while die costs are amortized through continued re-use.

No special tools are needed. All parts are interchangeable. The heavy duty series of punches and dies easily pierce material up to 1/4" mild steel.

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Technical Shorts..

A FASTER, MORE accurate method for detecting size and quantity of silica in dust has recently been perfected by scientists at Bausch & Lomb Optical Co.

Germain Crossmon, biological and chemical microscopist has demonstrated the technique, which is expected to prove valuable in the prevention of silicosis and other industrial lung diseases.

In his method, called dispersion staining, a drop or two of a liquid having the same refractive index as free silica is added to a dust sample. The preparation is then examined with either a dark-field or phase contrast microscope employing polarized or unpolarized light. The silica particles appear to be stained, under this examination, and are easily identified; thus can be readily measured as to size and quantity.

The same technique is applicable, according to Mr. Crossmon, for determining the presence of other toxic dusts such as chrysotile.

THE AMERICAN STANDARDS Association has announced approval of a standard for inspection of fine-pitch gears, B6.11-1951, covering general gears; spur and helical gears; worms; bevel gears; backlash in gears; comparator layouts; blanks for fine-pitch gears; pin measurements; fine-pitch master gears; and surface roughness. Fine pitch gears are defined as gears of 20-diametral pitch and finer.

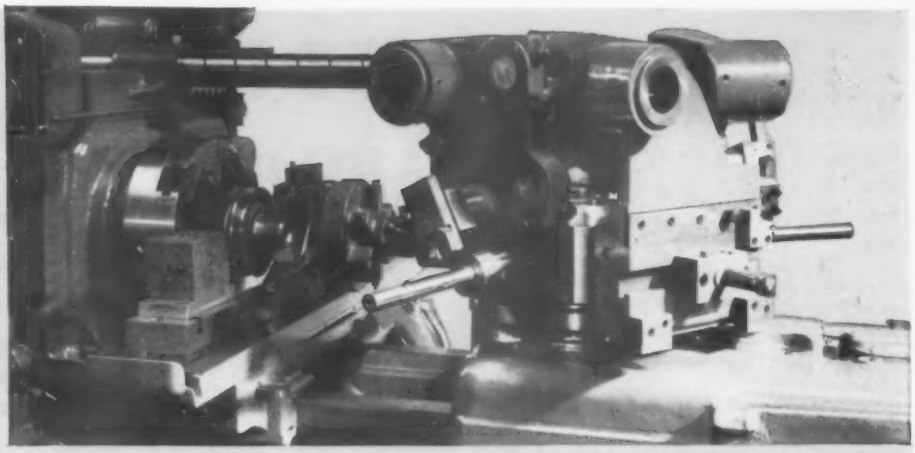
The new standard is based on a combination of the two developed for inspection by the American Gear Manufacturers Association during World War II plus a section on surface roughness requirements.

Recommendations contained in B6.11-1951 suggest maximum roughness height values range from ½ to 1000 microinches, and maximum waviness height values from 0.00002 to 0.020 inches.

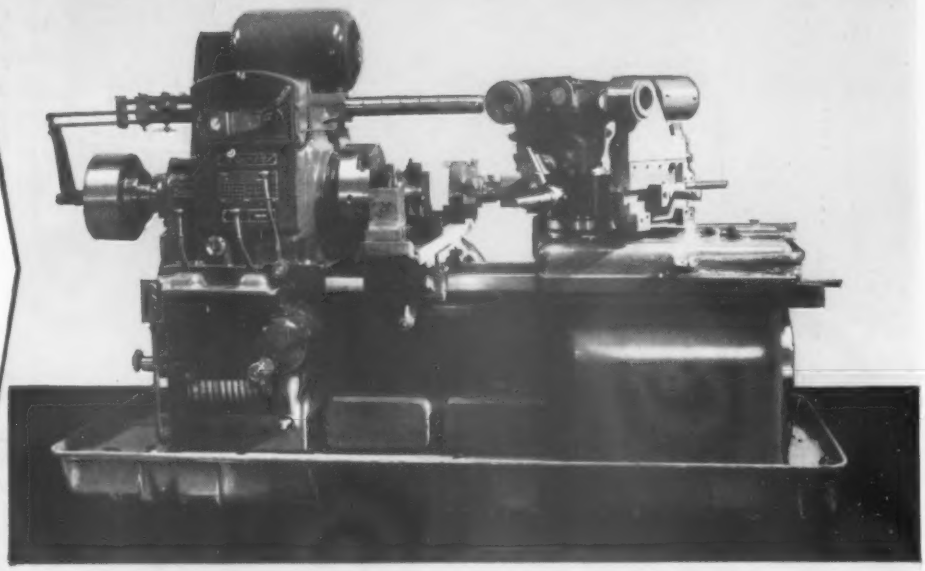
Also in the new section are definitions; surface symbols; symbols indicating direction of lay, and symbols indicating gear tooth zone.

Part of the gear standardization program developed by a committee organized under the procedure of the ASA and sponsored by the American Gear Manufacturers Association and the American Society of Mechanical Engineers, the standard is available either from the ASA or the ASME.

THIS KIND OF
PRODUCTION TOOLING



ON THE
POTTER & JOHNSTON 5D AUTOMATIC



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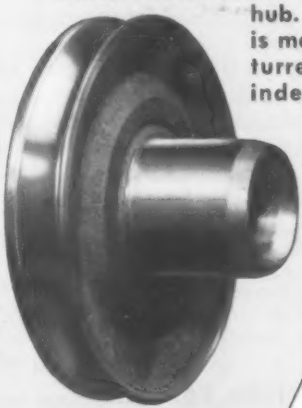
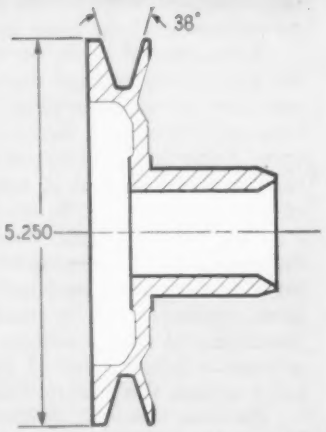
FASTER–BETTER
and with
FEWER REJECTS

P&J-designed Tungsten Carbide Tooling does a speedier job of rough-machining and precision-finishing all the surfaces indicated by heavy lines in this Pulley drawing. Note the ingenious Slide Tool which chamfers the inner end of the hub. The outer bevel is machined when the turret automatically indexes to the next position. This single P&J Tooling set-up turns out better than 10 Pulleys per hour at 85% efficiency on the P&J 5D AUTOMATIC.





Numerous similar examples of P&J Precision Tooling on P&J AUTOMATICS are shown in this free Booklet, "Productivity with Economy." Write for your copy.

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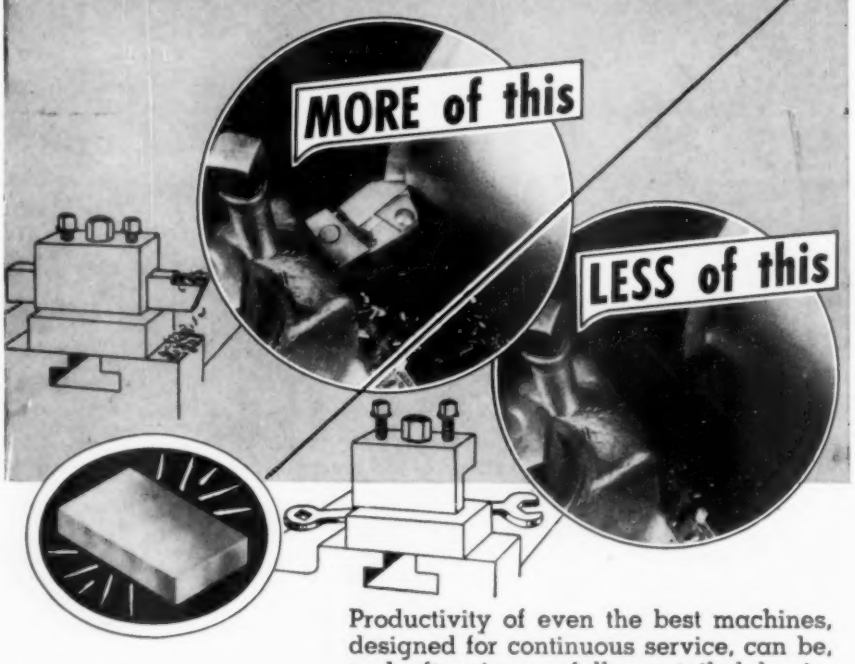
HOW TO REDUCE "LOST-BUT-PAID-FOR" MACHINE HOURS



Productivity of even the best machines, designed for continuous service, can be, and often is, woefully curtailed by inferior tools that wear rapidly and require frequent shutdown for replacement. Production is thereby recurrently interrupted, *but* costs never cease. Lost time must be paid for.

Kennametal tools, on the contrary, have a remarkably long service life. Outstanding durability is inherent. They work more hours per day, spend less time in the grinding room, and thus help reduce idle machine time, make operators more efficient, reduce tool inventory. Superior performance is attained because the physical structure of Kennametal is sound and uniform — the desired properties of hardness, strength, and toughness are consistent.

These outstanding characteristics are achieved through a unique coordination of manufacture and all-inclusive control from raw materials to finished product — refinement of all carbides directly from ores, oxides, and by-products — processing of these carbides into Kennametal compositions by exclusive methods and patented techniques — fabrication of complete tools and wear-part designs that fully utilize the distinctive properties of Kennametal.

For those who wish assistance in developing the most efficient tool applications Kennametal Inc. maintains a corps of competent Field Engineers in all important industrial centers. Their services are available for helping you to reduce lost-but-paid-for machine hours.

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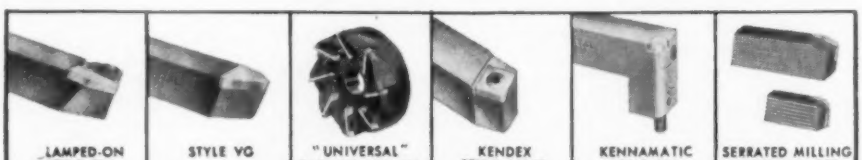

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Good Reading

A GUIDE TO SIGNIFICANT BOOKS AND PAMPHLETS OF INTEREST TO TOOL ENGINEERS

SYMPOSIUM ON ULTRASONIC TESTING, as presented at the 52nd Annual Meeting of the American Society for Testing Materials, publishers of the book. 140 pp.; price $2.00.

Papers include: Ultrasonic Wave Propagation in Materials; Basic Principles of Ultrasonic Testing; Ultrasonics in the Heavy Forging Industry . . . ; in Fabrication of Aluminum . . . ; in the Electrical Industry, and so on through to The Measurement of Dynamic Modulus on Adhesive Joints at Ultrasonic Frequencies. The book is available from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

PRODUCTION OF MOTOR VEHICLES, by Henry M. Cunningham and William F. Sherman. Published by McGraw-Hill Book Company, New York, N.Y. 170 pp.; price $3.50.

This book was written for the industrial College of the Armed Forces to meet the expressed need for a guide to managerial techniques in the planning, scheduling and manufacture of motor vehicles. And while slanted to the needs of those concerned with automotive production methods, it will provide interesting and instructive reading for the public, which usually sees the automobile as a finished product.

For this book takes the reader through the entire process of automobile manufacture from inception of a new model through shipping of the finished product; shows the involved steps of coordinating assembly of stock models to the precisely timed spotting of components along the assembly lines for the special job.

The book describes the preliminary activities of sales, engineering and purchasing departments; discusses the initial survey to establish plant, equipment and manpower requirements; considers design, specifications and tooling, and selection and procurement of machinery; and examines final cost determination and scheduling of actual manufacture of new models. In addition, there is concise analysis of methods used in quantity, quality, and cost control, and the relationship of dealer orders to scheduling, and the rule of the traffic department in shipping.

In all, the book provides a better understanding of the managerial techniques involved in motor vehicle planning, scheduling and manufacture.

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GROUND with THREAD CHASERS

These Die Heads will do an outstanding job on large or small lots, in pitches ranging from extremely fine to coarse multiple Acme.

They are versatile tools with an over-all capacity of from No. 8 to 4¼".

They require no more than the proper chasers to cut either right- or left-hand threads. No extra equipment is needed.

They are easy to install and simple to handle. For almost half a century J&L Dies and Chasers have been the answer to a multitude of threading jobs throughout the world.

Look at these features that make them leaders in their field and give you better threads at lower cost:

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Every part is of solid steel, hardened and precision ground. There are no built-up sections. Dependability and ultimate capacity are assured.

FLOAT
All models are built with both concentric and longitudinal float.

DUAL-DIAMETER CONTROL LEVER FOR ROUGHING AND FINISHING CUTS
Heavy rough cuts, followed by light, accurate finish cuts can be taken with the same set of chasers by merely moving the roughing attachment lever. This is often a chaser saver on heavy, coarse pitch jobs, especially where short chamfers are a requirement.

SIZE ADJUSTMENT
The external micrometer adjusting screw provides simple and precise setting to exact pitch diameter. It is easy to set and maintain sizes well within your thread tolerances.

RAPID CHASER CHANGE-OVER
Chasers are removed for resharpening, or size replacement, by merely removing the front cover of the Die. No tools are required. Change-over is a matter of seconds — which means more hours available for production.

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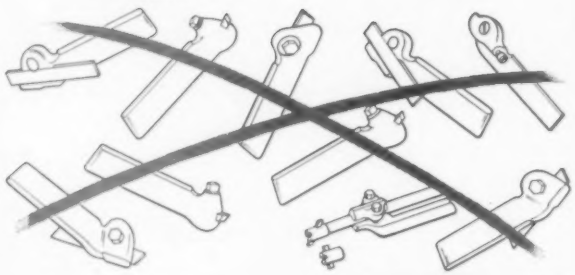
ONE ALL PURPOSE TOOL HOLDER INSTEAD OF TEN



ONE tool holder for all positions—No tool chatter—can do internal boring or internal threading—Ideal for carbide tools—Bit sizes: ¼", 5/16", 3/8", 7/16"

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Use MEEHANITE METAL TOOLS to be sure of accuracy and precision in checking flats, angles or heights. MEEHANITE METAL TOOLS are heat treated and have either hand scraped, ground or planed surfaces; and, are designed to give you long, reliable service.

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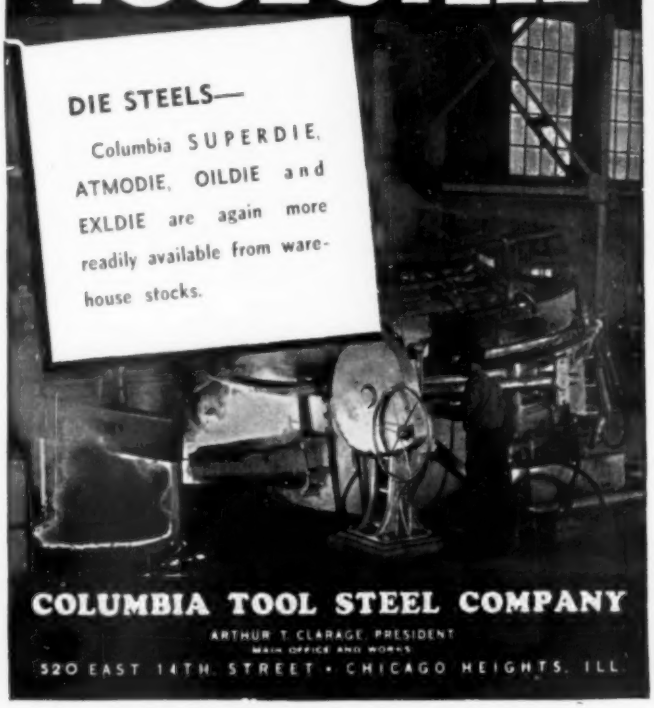
Columbia SUPERDIE, ATMODIE, OILDIE and EXLDIE are again more readily available from warehouse stocks.



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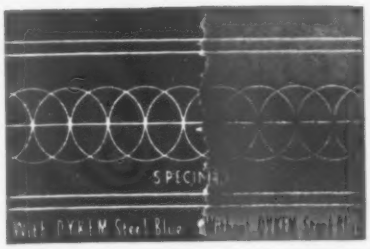
STOPS LOSSES

making dies & templates



Simply brush on right at the bench; ready for the layout in a few minutes. The dark blue background makes the scribed layout show up in sharp relief and at the same time prevents metal glare. Increases efficiency and accuracy.

Write for full information

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This CERROMATRIX die guaranteed for 2,000,000 blanks!

Lang Tool and Die Manufacturing Company, Glendale, California, use Cerromatrix to anchor small punches in high-production lamination dies. They guarantee these dies for 2,000,000 blanks minimum.

Punches are held vertically by cap screws and mounted in Cerromatrix. Very small punches are held by circular washers outside and inside of punch, located in a ⅛" groove ground in the punch. All small punches are guided through a fixed stripper with Nitrided inserts.

At least ⅓ of the length of the punches is held in Cerromatrix. The photograph shows a die for rotor and stator blanks. It runs 135 strokes per minute. Eighty to eighty-five thousand blanks are obtained per sharpening of die. Send for literature.

CERRO de PASCO Corporation
(Formerly CERRO de PASCO Copper Corporation)
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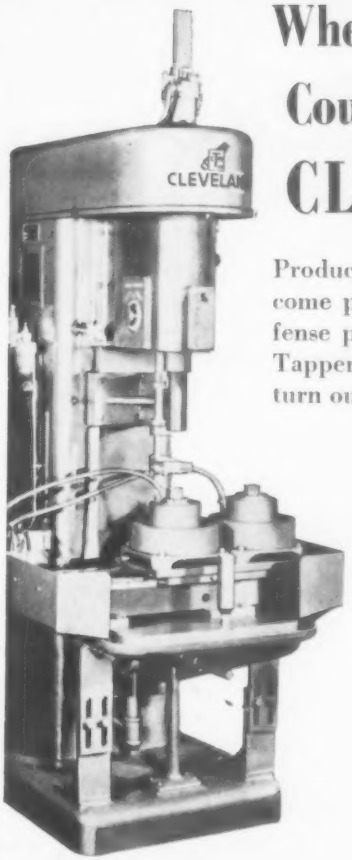
CLEVELAND tapping machines *lead screw*

When Every Hour Counts...Rely on CLEVELAND



A CLEVELAND TAPPER set up on a munitions job, tapping a 1 15/32", 16-pitch Buttress thread in SAE 4143 steel tubing hardened to 35 to 37 Rockwell.

Production hours saved can become pretty important in a defense program... and Cleveland Tappers save production time... turn out more perfect pieces per hour. They cut tapping costs by combining operations...turn semi-skilled workers into skilled operators. Cleveland engineers can design a machine for your needs which will not only combine several operations but also tap groups of holes at one stroke of the machine. If you have a production problem check with Cleveland FIRST.

Cleveland offers all these features

- Precision hardened and ground lead screw.
- Fully automatic or manual control.
- Precision depth control for blind hole tapping.
- Heat treated alloy steel spindles for maximum strength.
- Easily changed spindle speeds.
- Exclusive super sensitive clutch reduces breakage and increases tap life.
- Positive coolant and lubricant supply under constant control of operator.
- Rigidly constructed to give years of service.
- Maximum safety for operator and machine.

Meet Mr. Lead Screw

of The Cleveland Tapping Machine Co. Mr. Lead Screw symbolizes the time-proved lead screw feed designed and pioneered by Cleveland . . . now generally accepted as the key to precision tapping at high speeds. Write for your copy of the Cleveland Production Tapping Guide and a copy of Catalog T-6

THE CLEVELAND TAPPING MACHINE CO.
A Subsidiary of AUTOMATIC STEEL PRODUCTS, INC. · CANTON 5, OHIO

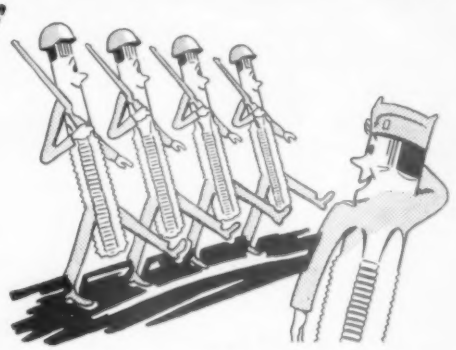
USE READER SERVICE CARD; INDICATE A-8-97-4

Herman Van Jones had an every-day name,
So he tried a queer stunt to break into fame.

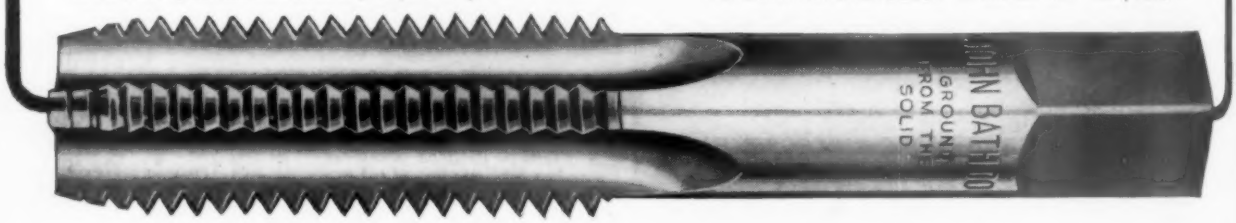
But when Uncle Sam called and broke up his slumbers,
A "tap" on Herm's knee, changed his name into numbers.

JOHN BATH CO. INC. · WORCESTER · MASS ·

Now — the name BATH is known, beyond all conjecture
To be plainly marked on each tap to protect-ya.



This tap always passes, with a reflex that cheers,
For BATH TAPS have been "in the service" for years.



INSIST ON BATH TAPS . . . PROFIT BY THEIR PLUS-PERFORMANCE

Bath Taps are playing an important part in precision production today, especially where a better quality of thread is specified. Quality has long been associated with BATH TAPS because they are "ground from the solid" — a process that removes all danger of distortion in close tolerance work. Right now, when spoilage must be cut to a minimum, insist on BATH TAPS for economy. Whether you require taps made to standard or special size . . . we'll be glad to help you with any of your threading problems.

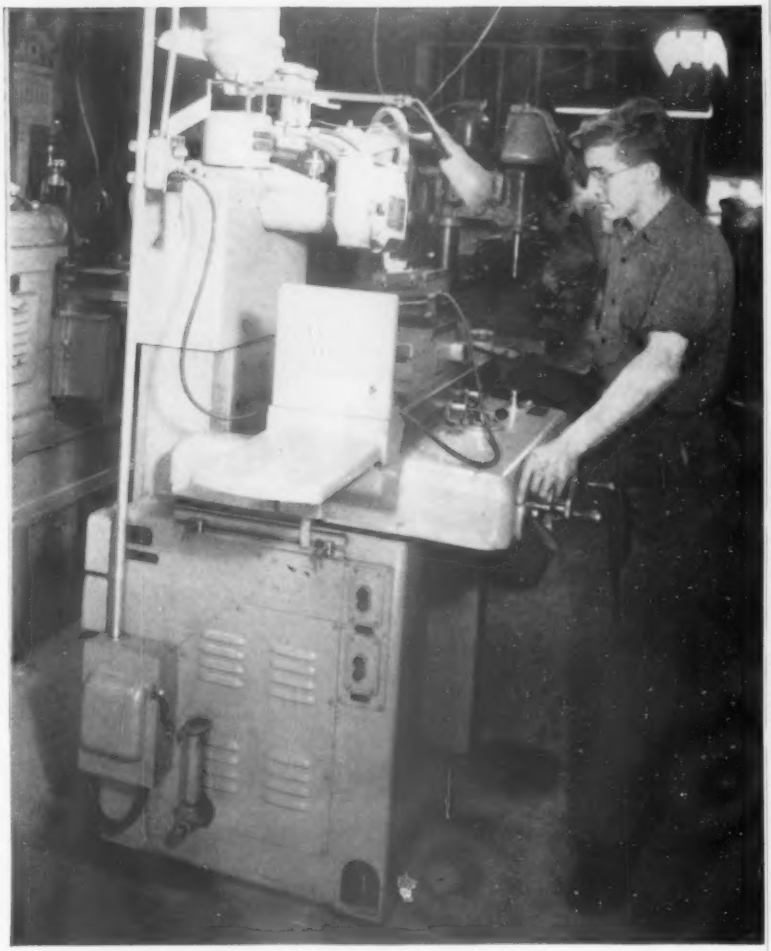
PLUG AND RING THREAD GAGES • GROUND THREAD TAPS • INTERNAL MICROMETERS

JOHN BATH CO. INCORPORATED
28 Grafton St., Worcester, Mass.

FOR FURTHER INFORMATION USE READER SERVICE CARD; INDICATE A-8-98

SAVES 5½ HOURS GRINDING FORM TOOL

DoALL "COOL-GRINDING"
(U.S. PATENT NO. 2470350)
PRINCIPLE MAKES POSSIBLE FASTER WORK, GIVES STRAIGHTER CUT, PREVENTS WARPING



TAKE a tip from Biddle Screw Products, Sheridan, Indiana. The carbide bar in one of their large screw machines would warp under normal cutting conditions. The cut was taking ¾ of a day and the piece wasn't always satisfactory.

Then they turned to DoALL "Cool-Grinding" of the carbide bar. The coolant *flows through* the wheel and atomizes at the point of work. *Standard wheels are used.*

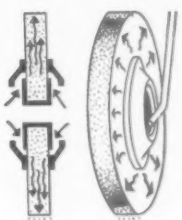
RESULTS? No warping, a straight cut, perfect pieces — *and only 30 minutes to do the job!*

You wouldn't believe tool grinding could be that important, but DoALL "Cool-Grinding" *does* produce *amazing* results everywhere it is used.

SEE FOR YOURSELF. Ask to have a Free DEMONSTRATION right in your own plant. Call your local DoALL Sales-Service Store or write:

THE DoALL COMPANY • 254 N. Laurel Ave., Des Plaines, Ill.

"COOL-GRINDING" COOLS AT THE POINT OF CONTACT . . .



Coolant is metered into the hub of the wheel, forced centrifugally through the pores and out in a fine mist *at the point of contact of wheel and work.* No other system can do this. No other system gives such fast, smooth, accurate results with no burning or checking.

SEND FOR CATALOG TODAY

—find out how "Cool-Grinding" works, learn all of its time, labor and money-saving benefits. Lists all models of DoALL Precision Grinders for toolroom and production work.

GR-1

INDUSTRY'S NEW TOOLS

DoALL

27 SALES-SERVICE STORES

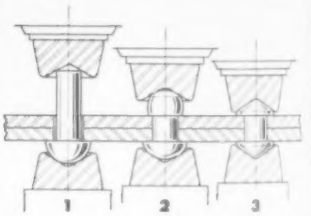
Machine Tools . . . Gaging Equipment . . . Tool Steel . . . Band Tools . . . Metal Working Supplies

QUIET *riveters at work*

. . . not a sound as ⅜″ rivets are cold formed in 2½ seconds . . . each the exact counterpart of its neighbor. The power source, a complete, self-contained, compact hydraulic pressure generator. The tool, unique and easily handled, is controlled by the touch of a button—fast, smooth, precise, automatic AND SILENT! Hannifin "Hy-Power" portable or stationary units are available in capacities from 5 tons to 100 tons (more in multiple) for riveting, punching, pressing, assembly or shearing.

Hannifin hydraulic and pneumatic machines can profitably serve you in many ways . . . consult our engineers on the possibilities. Hannifin Corporation, 1119 S. Kilbourn Ave., Chicago 24, Ill.

The quiet "Hy-Power" Hydraulic Work Cycle



Hydraulic pressure, under instant, reversible, finger-tip control, silently squeezes rivets in this manner:

1. Fast approach (completed)
2. Rivet being squeezed
3. Rivet formed; ram returns

"Hy-Power" Hydraulics should be in your design file. Ask for Bulletin 150. Your copy will be supplied promptly.

do ALL you CAN do . . . with

HANNIFIN

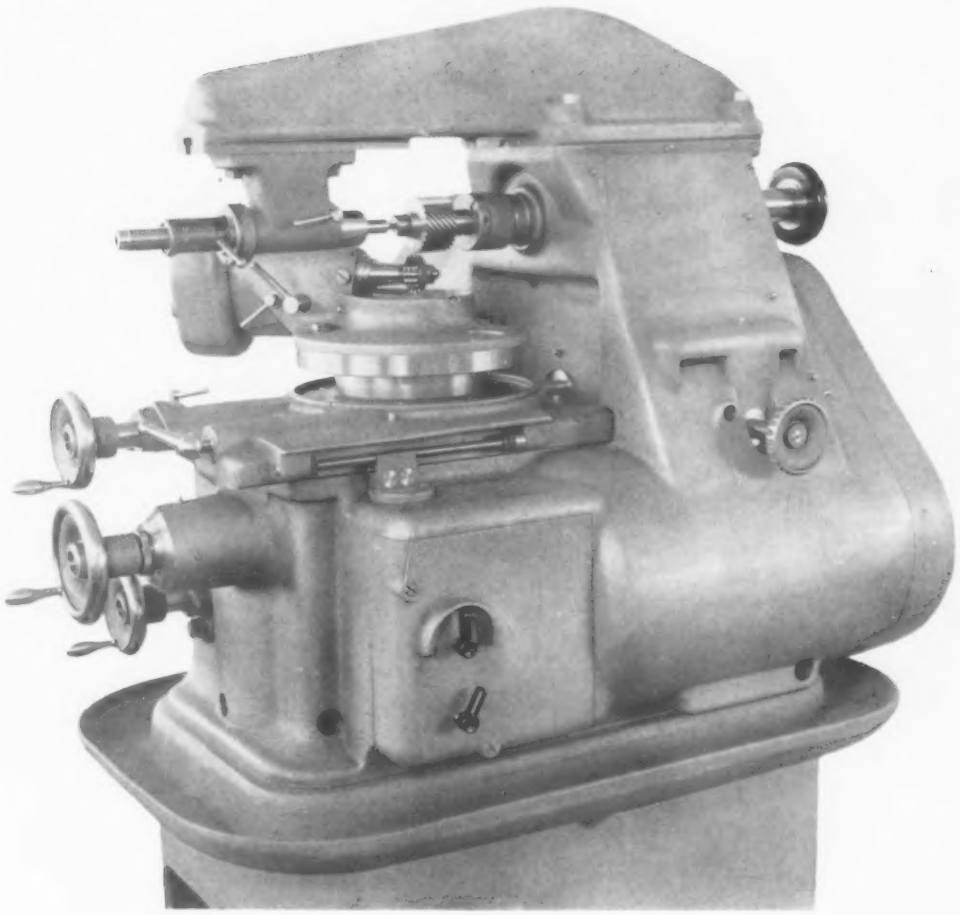
Field Engineers In All Leading Industrial Centers

Air Cylinders • Hydraulic Cylinders • Hydraulic Presses • Pneumatic Presses • Hydraulic Riveters • Air Control Valves

«MIKRON» GEAR MAKING MACHINES . . .

are designed and built to produce a product of exceptional accuracy and finish, which will be maintained through years of service.

Made in several models with capacity from 12 D.P. to the finest, and up to 7½" diameter.



SPUR GEARS
SPIRAL GEARS
BEVEL AND CROWN GEARS
WORM GEARS

INTERNAL GEARS
SEGMENT GEARS
RACKS
WORM WHEELS

MULTISTART INTERNAL AND EXTERNAL GEARS

RUSSELL, HOLBROOK & HENDERSON, INC.

292 MADISON AVE. • NEW YORK 17, N.Y.

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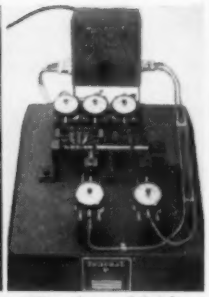
Federal Dimensionair Air Gage.



Electricator Multi-Dimension Gage.

WE MAKE GAGES!

If you think of us solely as the makers of world-famous Federal Dial Indicators, here are a few points to remember.

DO YOU KNOW that for over twenty years Federal has been making complete gages for controlling dimensions?

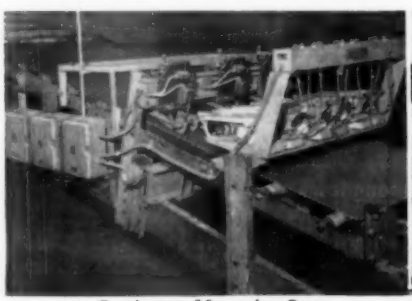
DO YOU KNOW we have over 20,000 gage designs in our engineering files right now?

DO YOU KNOW there's undoubtedly a design in our files that's right for your job, requiring the barest minimum of adaptation or special design work?

DO YOU KNOW Federal Gages work fast, read easily, and reduce operator fatigue because they're backed by experience? For example, the efficient gage we made yesterday for a manufacturer of automotive equipment helps us design and build an efficient gage for you tomorrow — whether you manufacture refrigerators or radios, razor blades or rivets.

DO YOU KNOW our nationwide gage engineering staff is another big reason why so many leading industries come to Federal for Dimensional Gages?

When you have a dimensional control problem, put it up to Federal. Send blueprints indicating dimensions to be checked. No obligation. Also ask for Catalog 51. FEDERAL PRODUCTS CORPORATION, 1198 Eddy Street, Providence 1, Rhode Island.



Continuous Measuring Gage.

Electronic Sorting Gage.

FEDERAL

Largest manufacturer of indicating type gages . . . exclusively.

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DRILL HARDENED STEEL WITHOUT ANNEALING WITH "HI-ROCKWELL" DRILLS

Every toolroom needs Champion "Hi-Rockwell" drills. These tools drill precision holes in steels testing C-40 to C-68 Rockwell quickly and without annealing. Ideal for reworking tools and dies, they actually cut a curled chip! *THEY CUT!!!*

Some sales territories open.

Available in standard sizes—from stock of:

CHAMPION TOOL CO.

24060 Orchard Lake Rd. Farmington, Michigan

We also are the manufacturers of the Nu-Mikro piston grooving tools.

USE READER SERVICE CARD; INDICATE A-8-102-2

WHO*

looks more like a busy, little beaver than a wise, old owl these days. But WHO* is still—

Wm. H. Ottemiller* Co.

of YORK, PA.

Even though the need for our precision, "milled-from-the-bar" screw machine products has us virtually snowed under—we invite inquiries from those of you who must have "the best."

USE READER SERVICE CARD; INDICATE A-8-102-3

MODERNIZE YOUR TURRET LATHES

WITH NEW "DONUT" DESIGN AIR CYLINDERS

PERMITS BAR STOCK TO PASS THROUGH CYLINDER

Get more production from your turret lathes on bar stock operations. Convert from hand-operated chucking devices to automatic chucking and release with Erickson's New Lever Type "Donut" Design Air Cylinder.

This single-acting cylinder can be set up for either push or pull mechanisms. When combined with an automatic bar feed, the Erickson "Donut" Design Air Cylinder provides for fully automatic handling of stock. All the operator does is touch the air control valve—the cylinder does the rest.

GET COST-CUTTING FACTS NOW!

Learn how the amazing new Erickson Air Cylinder can mean greater production efficiency for you.

Write for Catalog D

ERICKSON TOOLS DIVISION

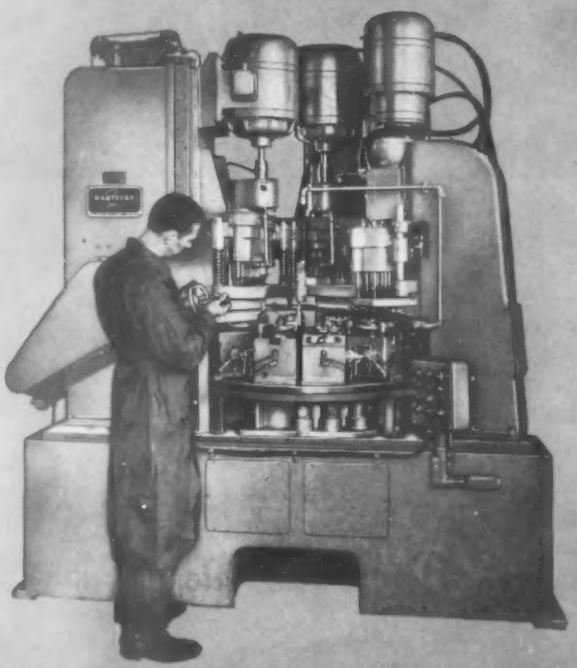
2316B HAMILTON AVE. CLEVELAND 14, OHIO

USE READER SERVICE CARD; INDICATE A-8-102-4

When it comes to production- come to Hartford Special

This part has

59 OPERATIONS including facing, milling, drilling, tapping, reaming, boring, turning, and chamfering.



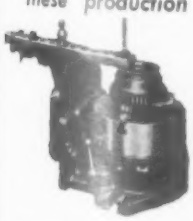
240 PCS. PER HOUR produced on this

HARTFORD SPECIAL AUTOMATIC DRILLING & TAPPING MACHINE

WRITE FOR BULLETIN NOW!

HARTFORD *Special*

Hartford Special also makes these production machines



SUPER-SPACERS

Automatic THREAD ROLLERS

DIE POLISHERS

THE HARTFORD SPECIAL MACHINERY CO.
HARTFORD 12, CONNECTICUT

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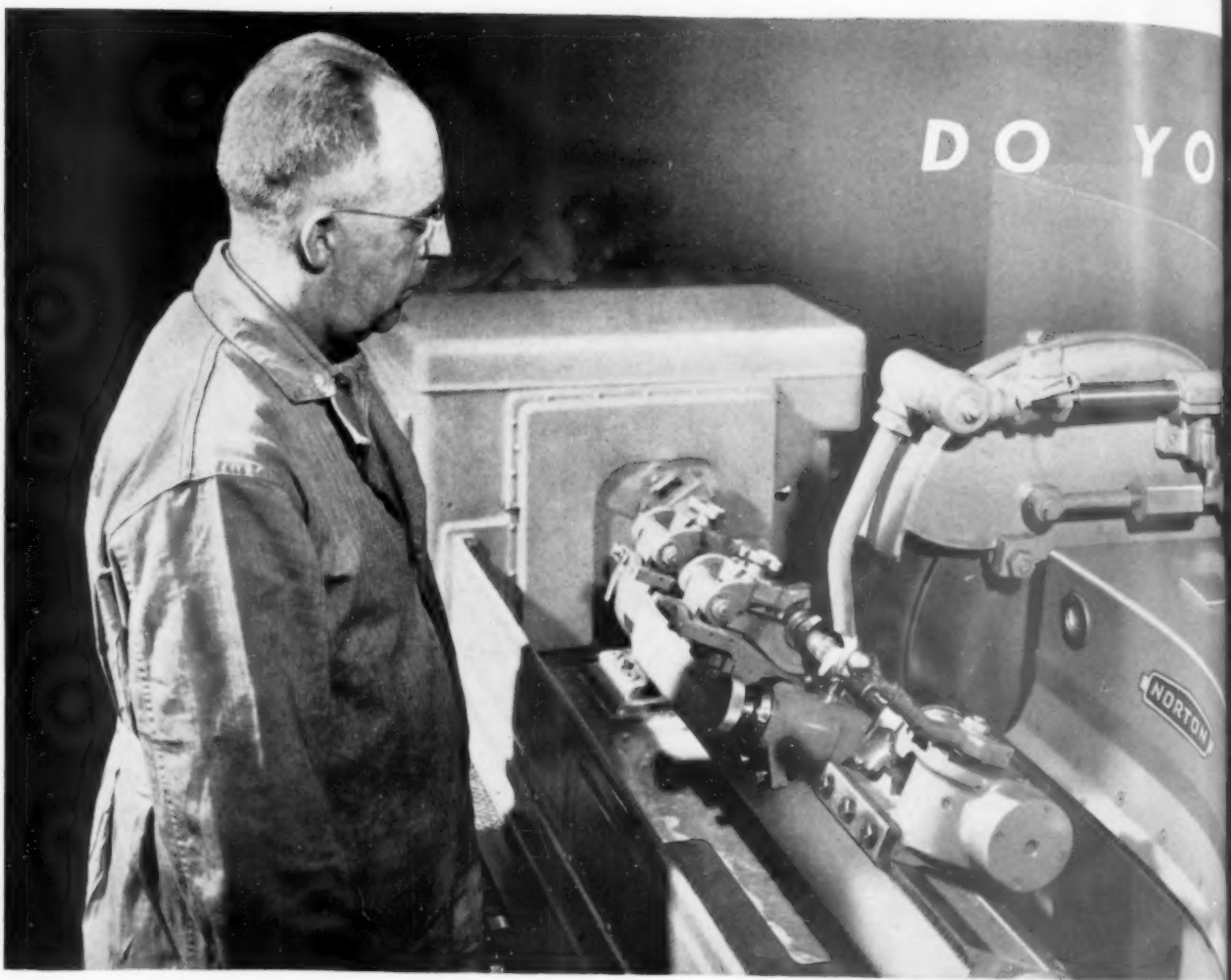
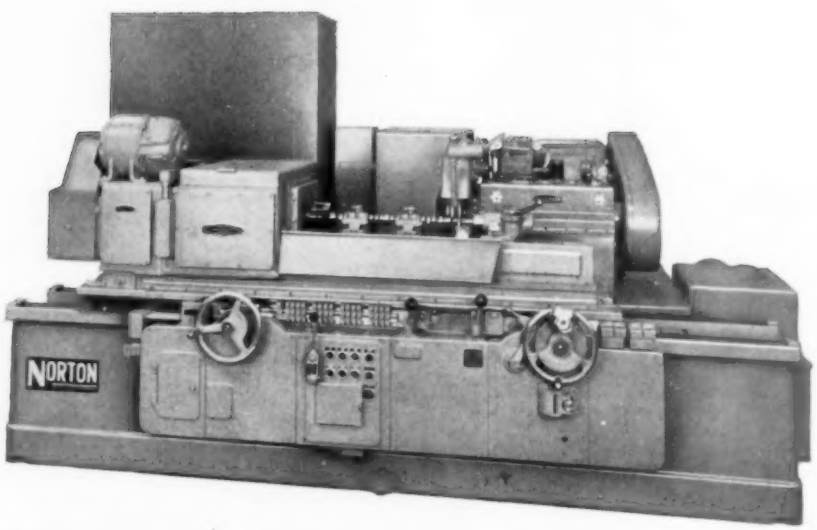


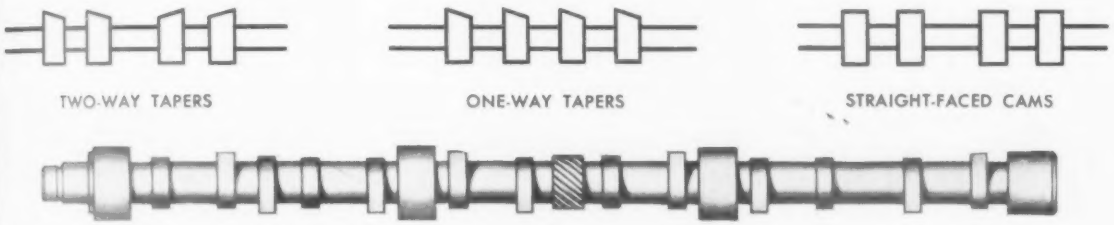


NORTON NO. 2
CAM-O-MATIC
AUTOMATIC
Cam Grinder

Making better products to make other products better

with the new *swiveling wheel slide feature of the NORTON No. 2 CAM-O-MATIC Machine you can speedily produce two-way tapers one-way tapers or straight-faced cams**

***PATENTED BY NORTON**



Are your camshafts designed with tapered cams, or is this requirement anticipated in the future?

If so, the new Norton patented feature which makes it possible to grind two-way or one-way tapers — or to grind straight-faced cams at any time by means of a simple adjustment, greatly increases the capacity of the No. 2 CAM-O-MATIC Machine to fully meet your present or future requirements.

Investigate the possibilities of this new feature. It puts extreme versatility constantly at your command.

NORTON

GRINDERS and LAPPERS

NORTON COMPANY, WORCESTER 6, MASS.

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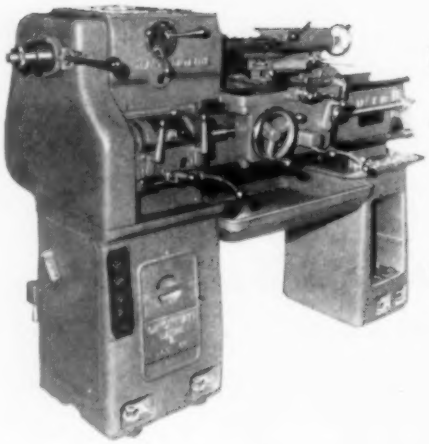


Low initial tool investment, minimum setup time, simp
setup changes on a wide variety of jobs, and more work turned o
per working day . . . these are the chief reasons why Americ
Lava Corp., Chattanooga, Tenn., bought Cincinnati Tray-Top light du
engine lathes for turning ceramic condensor shaft
Tray-Top proved a sound investment. Mr. R. B. Williams, ceramic engi
neer, reports: "With a multiple tool block on the lathe compound
two or more brass sleeves are turned on the shafts simultaneously
Diameters are easily held within plus or minus half a thousandth
Tray-Tops' low cost saved us substantially on our original investment and
are well adapted to our operation." Catalog available on request

more work/hr. more work/dollar

CINCINNATI 9, OHIO, U.S.A.

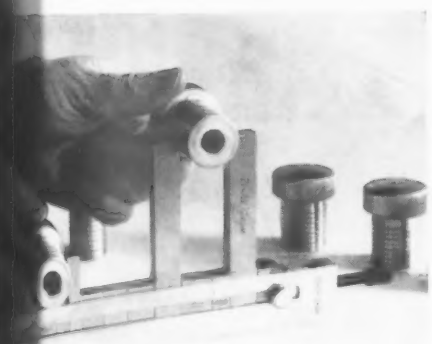
cincinnati·lathe & tool co.

This DoALL Gage Equipment

makes

120,000 SNAP GAGES

accurate in millionths



at about 1/4 cent each!

A SET of 83 DoALL Gage Blocks plus the Gage Holders and Caliper Jaws illustrated gives you thousands of go and no-go snap and internal gages for a fraction of a penny each—in a jiffy. You get millionth accuracy and dimensional stability that you can depend upon.

DoALL Gage Blocks are no luxury. They are reliable, economical working tools every plant should have—dependable insurance against rejects. Ask to have a DEMONSTRATION in your plant. Call your local DoALL Sales-Service Store or write:

THE DoALL COMPANY, 254 N. Laurel Ave., Des Plaines, Ill.

MODERN MEASUREMENT CONTROL

Send for this new 20 page Bulletin describing DoALL Gage Blocks and Accessories. Ask about DoALL Calibration Service for your present gage blocks!

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DoALL

27 SALES-SERVICE STORES

Machine Tools . . . Gaging Equipment . . . Tool Steel . . . Band Tools . . . Metal Working Supplie

a fixture lock to suit any requirement

AVOID SLOW OPERATING CLAMPS

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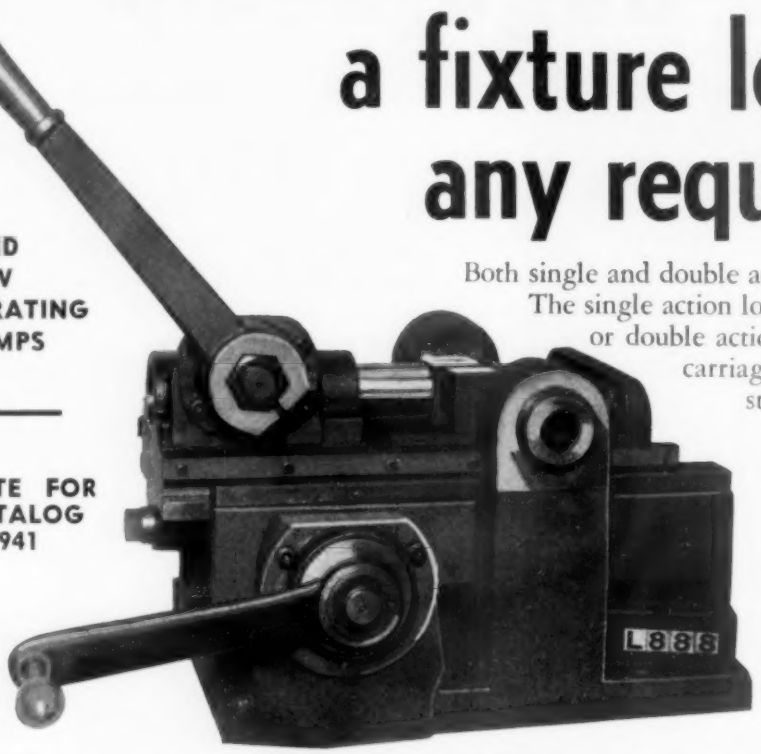

Both single and double action locks are used in this tooling. The single action lock clamps the part, while the lower or double action lock securely holds the movable carriage in the desired position against stops.

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ROTARY BROACH

- A NEW INVENTION!
- A NEW MACHINING METHOD! ROTARY BROACHING *
- A NEW NAME-"ROTARY BROACH" *

ROTARY BROACHES may be used in lathes, turret lathes, automatics, drill presses, etc., to replace reamers. They produce perfect holes with finishes that can only be compared to honing. They last longer before grinding is necessary and may be resharpened 10 to 30 times. They produce perfect holes at a fraction of the cost of those produced by other methods. Eliminates grinding, lapping, honing and boring.

USE THIS NEW MACHINING METHOD—ROTARY BROACHING*
You Cannot Afford Not To Use Rotary Broaches (Write for free descriptive literature)

* "Rotary Broach" and "Rotary Broaching" are new names coined and copyrighted by Shearcut Tool Company.

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When you want Perfect Holes, consult

SHEARCUT TOOL COMPANY

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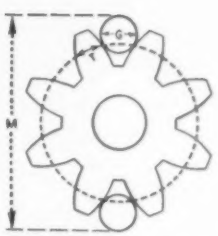
THE *Van Keuren*

simplified GEAR MEASURING SYSTEM



is the most accurate and economical method of measuring tooth thickness of external and internal spur gears, helical gears and involute splines.

External Spur Gear

STANDARD SIZES OF WIRES ARE AVAILABLE FROM STOCK

1.728"/DP for external spurs
1.44"/DP for internal spurs and 30° splines
1.92"/DP for enlarged pinions and 30° splines
1.68"/DP tentative alternate series

CATALOG AND HANDBOOK NO. 34

This 208 page volume represents 2 years of research sponsored by the Van Keuren Co. It presents for the first time in history a simple and exact method of measuring screws and worms with wires. It tells how to measure gears, splines and involute serrations. It is an accepted reference book for measuring problems and methods.

Copies free upon request

THE *Van Keuren* CO., 174 Waltham St., Watertown, Mass.

32nd YEAR

Light Wave Equipment • Light Wave Micrometers • Gage Blocks • Taper Insert Plug Gages • Wire Type Plug Gages • Measuring Wires • Thread Measuring Wires • Gear Measuring System • Sine Triangles • Carboloy Measuring Wires • Carboloy Plug Gages.

USE READER SERVICE CARD; INDICATE A-8-108-3

Why a Set-up Wheel?

For producing certain finishes and shapes today—there is no substitute for set-up wheels. In an increasing number of cases, however, belts and other abrasive products by CARBORUNDUM are coming into use, with marked success, where polishing grain had previously been used exclusively.

Behind this changing production pattern are new machines and techniques—matched at every step by new developments in abrasives and abrasive applications by CARBORUNDUM. Of equal importance to you, the user of abrasives, is our impartial recommendation of those abrasives best suited to your own job requirements.

Your CARBORUNDUM representative is a trained specialist who will be glad to help you select and apply abrasive products—including those which incorporate the latest developments in the field . . . whether they be polishing grain, coated or bonded abrasives.

Next time, call in CARBORUNDUM.

Only CARBORUNDUM
TRADE MARK

makes ALL abrasives to give you the proper ONE

"Carborundum" is a registered trademark which indicates manufacture by The Carborundum Company, Niagara Falls, N.Y.

"UP-ING UNCLE'S MUSCLE"

Bay State internal wheels have been "inducted" for a host of Defense Jobs . . .

Aircraft Cylinder Sleeves
Anti-Friction Bearings of All Kinds
Gun Barrels
Propellor Hub Cones
Connecting Rods
Aircraft Crankcase Assemblies
Cartridge Dies
Tank Turret Housings and Shields, etc. etc.

★ **THE ABRASIVE PRODUCT**
Bay State Internal Wheels . . . Quality Control Manufactured in Fractional Grades.

★ **THE GRINDING JOB**
Internal Grinding Crank Holes in Four Aircraft Conn Rods Simultaneously.

Ask for Bay State engineered-help on your next job.

BAY STATE

BAY STATE ABRASIVE PRODUCTS CO., Westboro, Mass.
Branch Offices and Warehouses — Chicago, Cleveland, Detroit, Pittsburgh
Distributors — All principal Cities
In Canada: Bay State Abrasive Products Co. (Canada) Ltd., Brantford, Ontario

★ KEEP AMERICA STRONG ★

Photo courtesy Production Machine Co., Greenfield, Mass.

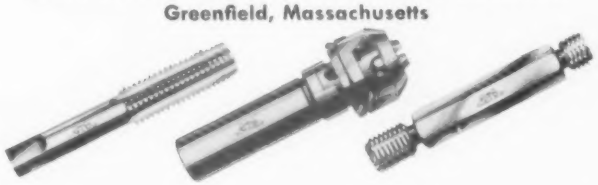
Tapping 8 pieces or 8000?

Whether your tapping application is a small-scale job depending on the skill of the operator, or a continuous large-scale operation where down time means troublesome production loss and taps just *have* to be right, you'll like GREENFIELD Taps and GREENFIELD Service.

And, whether you need only a few specially designed taps for a specific job or thousands of identical taps for year-in-year-out operation, you'll also like GREENFIELD Taps and GREENFIELD Service.

At "Greenfield" no tapping job is too small, and no tapping job is too large. For "Greenfield" Taps call your nearest Distributor.

GREENFIELD TAP AND DIE CORPORATION
Greenfield, Massachusetts



BUY GTD GREENFIELD!

Memo FROM CHIEF ENGINEER
Joe:
This is what Geometric call their "4 Heads in One" type with pull off and out-side trip for both automatics and hand machines.
The new aligning feature should lick the misalignment on those old automatics.
Don
#8 (.164" 32 NC3
1" X 45° 32
.240"
.238"
1" X 45° 32
7"-20 NF3 16
1" 8

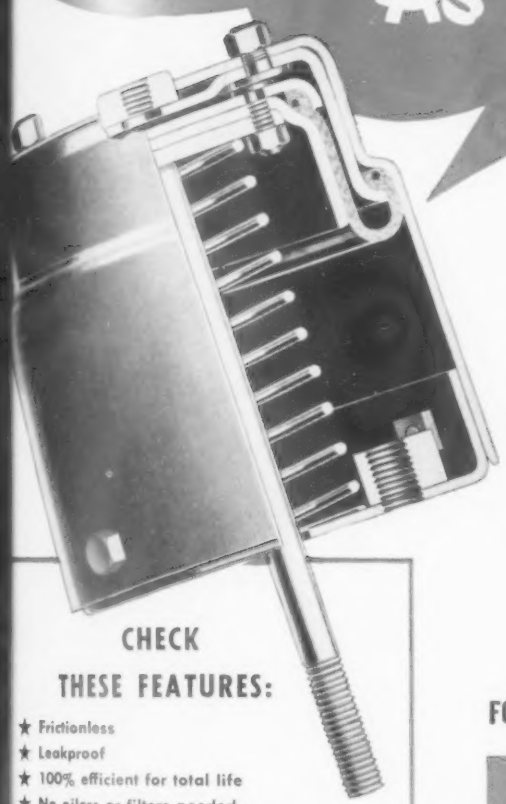
GEOMETRIC TOOL COMPANY DIVISION

Greenfield Tap and Die Corporation

NEW HAVEN 15, CONNECTICUT

ON OLD OR NEW MACHINE TOOL OPERATIONS—

YOU CAN STEP UP YOUR PRODUCTION AS MUCH AS 30%



....WITH THIS SIMPLE, RUGGED, LOW COST AIR CYLINDER!

The pressure for production is on! Manufacturers everywhere find it increasingly difficult to keep pace with the demands of the day. But there is a way—a brand new way requiring no addition to manpower, no addition to plant facilities. The answer? Remarkable Bendix-Westinghouse Robotair Industrial Controls. With their wide range of applications, Robotair controls offer you amazing improvements in production speed and economy through increased productivity of man and machine at *unbelievably low initial cost.* Robotair units are available as original equipment for machinery manufacturers or for easy installation on shop equipment.

Send today for an informative booklet and find out how you can cut costs, speed production with Robotair! Address Bendix-Westinghouse Automotive Air Brake Co., Dept. H, Elyria, Ohio.

CHECK THESE FEATURES:

- ★ Frictionless
- ★ Leakproof
- ★ 100% efficient for total life
- ★ No oilers or filters needed
- ★ Holding pressures up to 5000 lbs.
- ★ Diaphragm has rolling action and exceptionally long life
- ★ Made from high grade steel stamping—all metal parts cadmium plated
- ★ Chrome Molybdenum Steel Push Rod heat-treated for maximum toughness
- ★ Easily installed

FOR HOLDING, CLAMPING, BENDING, SWEDGING, STAKING, RIVETING

ROBOTAIR

THE INDUSTRIAL AIR CONTROL OF A THOUSAND USES

BENDIX-WESTINGHOUSE GENUINE ROBOTAIR

Bendix-Westinghouse

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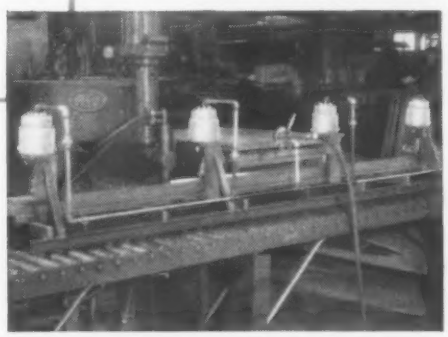
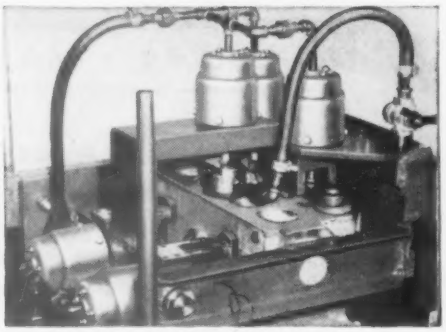


REDUCES OPERATOR FATIGUE

Four Rotochambers installed on the fixture in this spot welding operation replaced cumbersome hand clamps, saving time, greatly reducing operator fatigue.



SPEEDS INSPECTION METHODS

Installation of Rotochambers on this water test operation for engine castings eliminated hand operated fixtures, thereby speeding inspection and cutting costs.

PARKER · MAJESTIC PM **PRECISION MACHINES**

Above is pictured the home and products of the

PARKER-MAJESTIC, INC.

For over twenty-one years this company has manufactured the Parker Spindles used in Precision Grinding, Boring and Milling applications.

Supplementary products include the well known line of Parker-Majestic Internal, External, No. 2 Surface and Rotary Surface Grinders.

Descriptive literature upon request.

PARKER-MAJESTIC, INC.

formerly **MAJESTIC TOOL & MFG. CO.**

147 JOS. CAMPAU • DETROIT 7, MICHIGAN

IT'S A ROBERTSON COOL-CUT

The foreman of the grinding department of a big ordnance plant stared at the Robertson sales engineer in amazement. The foreman had been trying to take a .0001" cut off Hi-Carbon Hi-Chrome steel, Rockwell 68. The wheel he was using was getting nowhere. The Robertson sales engineer put on a Cool-Cut wheel and said, "Now don't *play* with it—take off .010" depth, with .015" cross-feed."

He tried it, and it worked! The Cool-Cut wheel took the metal off without heating the work and with no measurable wheel-loss. Chip-clearance of this revolutionary new wheel made it possible. The foreman said he'd never seen anything like it in his 45 years' experience. Now he knows that the Robertson sales engineer knew what he was talking about and that Cool-Cut wheels are precision-built for the *toughest* work. Fifty years' experience in the operation of high-temperature furnaces gives Robertson the know-how that makes them one of the most progressive grinding wheel manufacturers today, and assures them an increasingly important place in the field of industrial grinding.

FREE—*Write for this informative booklet* "HOW TO BUY PRODUCTION-TIME." *It contains facts about grinding wheels you never knew before!*

ROBERTSON MANUFACTURING CO.
TRENTON 5, NEW JERSEY

RESIN-BONDED AND VITRIFIED-BONDED GRINDING WHEELS • MOUNTED WHEELS • SEGMENTS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-115

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can solve *YOUR* *Wear-Resistance* problem

● WHAT JOBS HAVE YOU FOR CARMET CARBIDES TO DO?

For maximum wear, save with Carmet—preformed to practically any shape or size! *Examples:* entire blanking die parts; inserts for drawing, heading, extruding and blanking dies; gauge and wear parts, pins, bushings, etc. *Supplied Preformed* —with minimum grind stock allowed, or precision ground and ready for use. Let us work with you . . . send us your drawings and specifications for quotations. ● *Allegheny Ludlum Steel Corporation, Carbide Alloys Division, Wanda and Jarvis Avenues, Detroit 20, Mich.*

For complete MODERN Tooling, call

Allegheny Ludlum

AL
FINE TOOL STEELS
SINCE 1854

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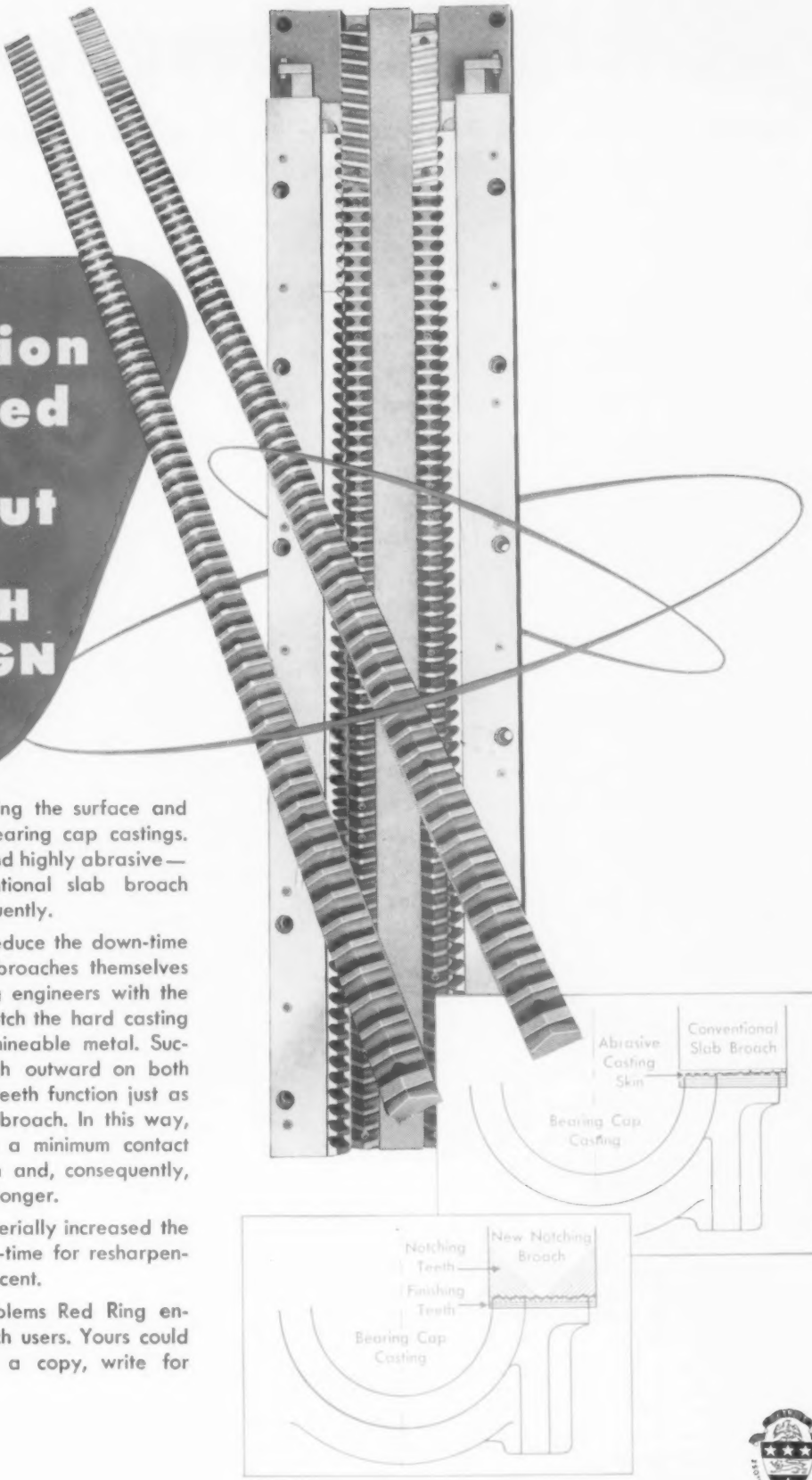
Production increased and costs cut by BROACH REDESIGN



The job in question is broaching the surface and edges of automotive main bearing cap castings. The surface skin is very hard and highly abrasive—so much so that the conventional slab broach requires sharpening very frequently.

To get more production and reduce the down-time for regrinding broaches, the broaches themselves were redesigned by Red Ring engineers with the forward teeth V-shaped to notch the hard casting surface down to readily machineable metal. Successive teeth extend the notch outward on both sides while the final finishing teeth function just as those of a conventional slab broach. In this way, broach teeth are exposed to a minimum contact with the abrasive casting skin and, consequently, hold their cutting edges much longer.

These new broaches have materially increased the parts per grind and the down-time for resharpening has been reduced 70 per cent.

This is one of the many problems Red Ring engineers have solved for broach users. Yours could be the next. If you haven't a copy, write for Bulletin 49-11 on broaching.

5643

NATIONAL BROACH AND MACHINE CO.

5600 ST. JEAN . . . . . DETROIT 13, MICHIGAN

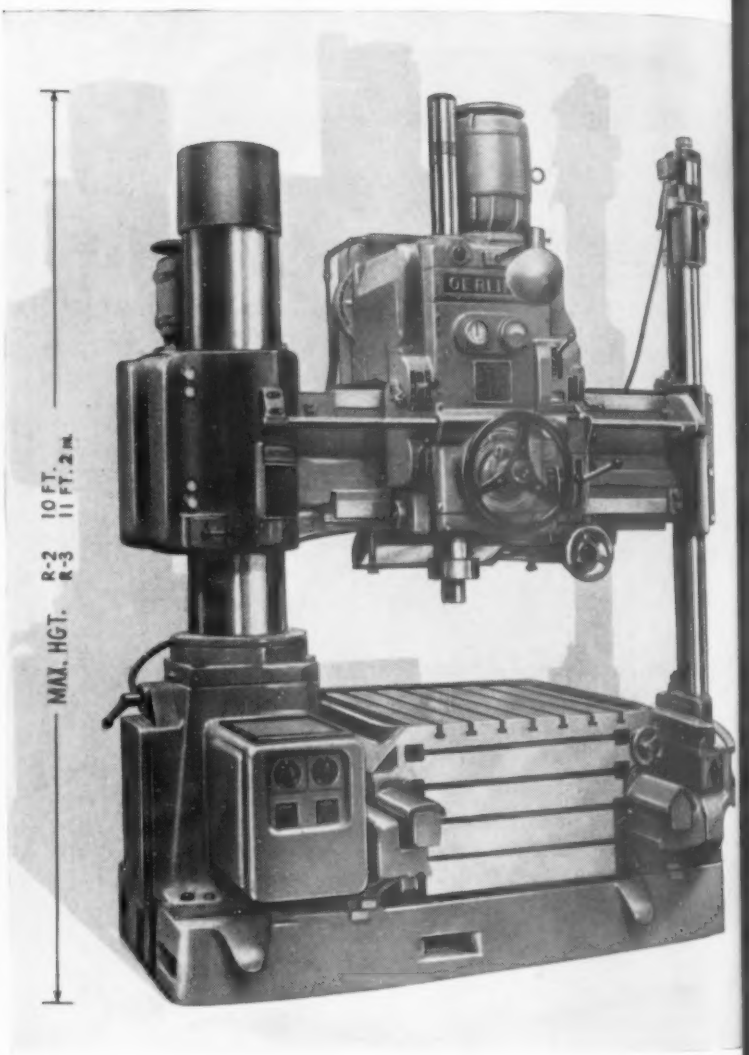
WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

OERLIKON PRODUCTION JIG BORER

For Precision and Production Boring • Drilling • Reaming • Tapping
Screw-Cutting • Facing • Outside Turning . . . . . without Jig

The absolute ruggedness and rigidity of this machine, combined with the broad range of 18 spindle speeds and 12 feeds, permits locating holes—by the coordinate method using gauge blocks or pins—to a tolerance of .0004" to .0008" between centers. Holes as small as .040" can be drilled.

The smaller column rides easily over a wide arc. Finger-tip pressure will move it. Rigid locking of the Boring Head, Cross Rail and Smaller Column, in any position, is accomplished by electro magnets controlled by a single switch. . . . These units can also be mechanically locked or released independently of each other. . . . A specially designed Tool Ejector facilitates rapid tool changes.



SEE THESE MACHINES IN OPERATION AT COSA'S NEW YORK SHOW ROOM OR SEND FOR DESCRIPTIVE LITERATURE.

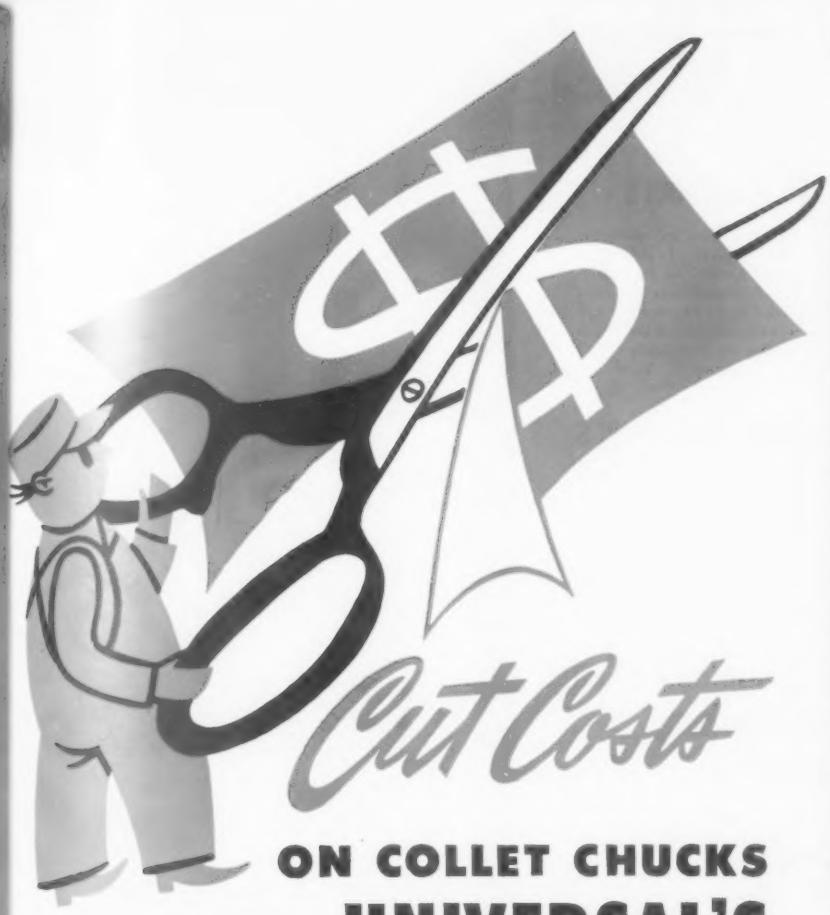
SPECIFICATIONS

	MODEL R-2	MODEL R-3	MODEL RE-35
Drilling Capacity in Cast Iron	2-3/16" at .018" per rev.	2-3/4" at .030" per rev.	2-3/4" at .030" per rev.
Drilling Capacity in Steel	1-3/4"	2-11/64"	2-11/64"
Motor for Boring Head	6 hp.	7.5 hp.	7.5 hp.
Max. Distance between Spindle and Table	27-9/16"	39-3/8"	46-9/16"
Max. Distance between Spindle and Base Plate	48"	59-5/8"	63-9/16"
Horizontal Travel of Boring Head	25-19/32"	28-3/8"	55-1/8"
Travel of Work Table	39-3/8"	47-1/4"	47-1/4"
Clearance between columns	58-5/8"	65-3/4"	89-9/16"
No. of Spindle Speeds	18	18	18
Spindle Speeds—R.P.M.	38 to 1900	30 to 1500	30 to 1500
No. of Boring Feeds	12	12	12
Boring Feeds—In. per rev.	.0012" to .031"	.0012" to .0472"	.001" to .05"
Net Weight	13,350 lbs.	17,260 lbs.	22,330 lbs.

COSA CORPORATION
405 Lexington Ave., New York 17

Your source for all Precision Machine Tools—from Small Bench Lathes to Large Boring Mills

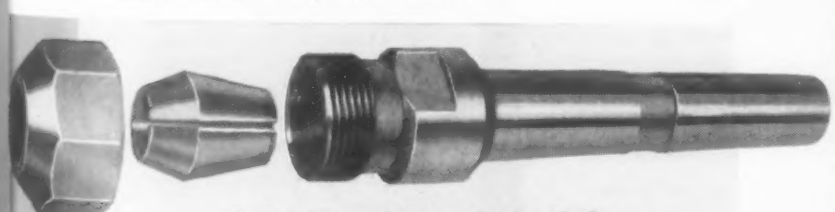
IN DETROIT AREA contact **DETROIT-COSA CORPORATION, 16923 James Couzens Highway, Detroit 35, Mich.**



Cut Costs

ON COLLET CHUCKS WITH UNIVERSAL'S SIMPLER DESIGN

Universal's collet chuck design with only three basic parts — nut, collet and chuck . . . means lower initial cost and less need for replacements because there are less wearing parts. This design not only saves money — it also provides wrap-around action, gripping on a continuous surface *the full length of the collet.* Drills can't slip, tool shanks don't get scored, tools run true and run-out is held at a minimum. Universal Collet Chucks are *available from stock* in collet sizes from 1/16" to 1½", to fit any screw machine. To cut chuck costs, write to the Universal warehouse nearest you . . . 1060 Broad Street, Newark, N. J., 5035 Sixth Ave., Kenosha, Wisc., or the home office.



Exploded view of Universal Collet Chuck illustrating simplicity of design

UNIVERSAL ENGINEERING COMPANY

FRANKENMUTH 3, MICHIGAN

149

OTHER UNIVERSAL PRODUCTION TOOLS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-119

Field Engineers

Wales Field Engineers are specialists in Wales equipment . . . selling no other line of tooling or machinery. These Field Engineers have had years of experience in the Engineering and Production Departments at the Wales plant and they are as valuable to you as the Wales Equipment.

Factory Engineers

A large percentage of the time of Wales Engineering Staff is spent consulting with customers and in developing and suggesting applications for Wales Standard Hole Punching and Notching Units. Save your valuable time and effort by sending your fabricating problems to Wales *first*.

Wales Hole Punching and Notching Equipment

Exclusive simplicity of set-up methods, reuse of the same units in unlimited patterns, permanent alignment of punches and dies are a few of the many reasons why thousands of manufacturers standardize on Wales Hole Punching and Notching Units in stamping presses and press brakes.

Wales Drilling Machine

This machine is specially designed, thoroughly engineered and ruggedly constructed to meet the precision requirements of locating, drilling and reaming holes in material of practically any length up to 36" wide. There is no other drilling machine or jig borer like it. It also fills a definite need in making templates for mounting Wales Units.

Wales Fabricator

Rapid interchangeability for punching, notching and nibbling is one of the outstanding features of the Wales Fabricator on limited production runs. Work from blueprints or operation sheets . . . no templates required. Wales "Quick Change" Holder permits interchanging punches and dies in a matter of seconds.

Wales Twin Column Presses

Simplicity of design and operation plus wide, unobstructed bed area permits straight through feeding of the work as well as feeding left to right. This complete line of presses may be used with all types of conventional dies as well as with Wales Hole Punching and Notching Units.

Only WALES offers you all these services and equipment

CALL ON WALES TO ASSIST IN SETTING UP YOUR METAL FABRICATING DEPARTMENT

By taking full advantage of Wales engineering experience, tooling techniques, drilling machines and press equipment, many production short cuts and economies are the direct result of coordinating and standardizing on Wales services and equipment.

One source insures one responsibility . . . a time saving economy that cannot be overlooked with today's high cost on production time.

The first step is to write, wire or call to have a factory trained Wales Field Engineer stop in to see you. You will discover his suggestions will be of assistance in stepping up production and reducing profit eating costs.

It's too big a story to tell on this page, so be sure to write, wire or call today.

WALES-STRIPPIT CORPORATION

George F. Wales, Chairman

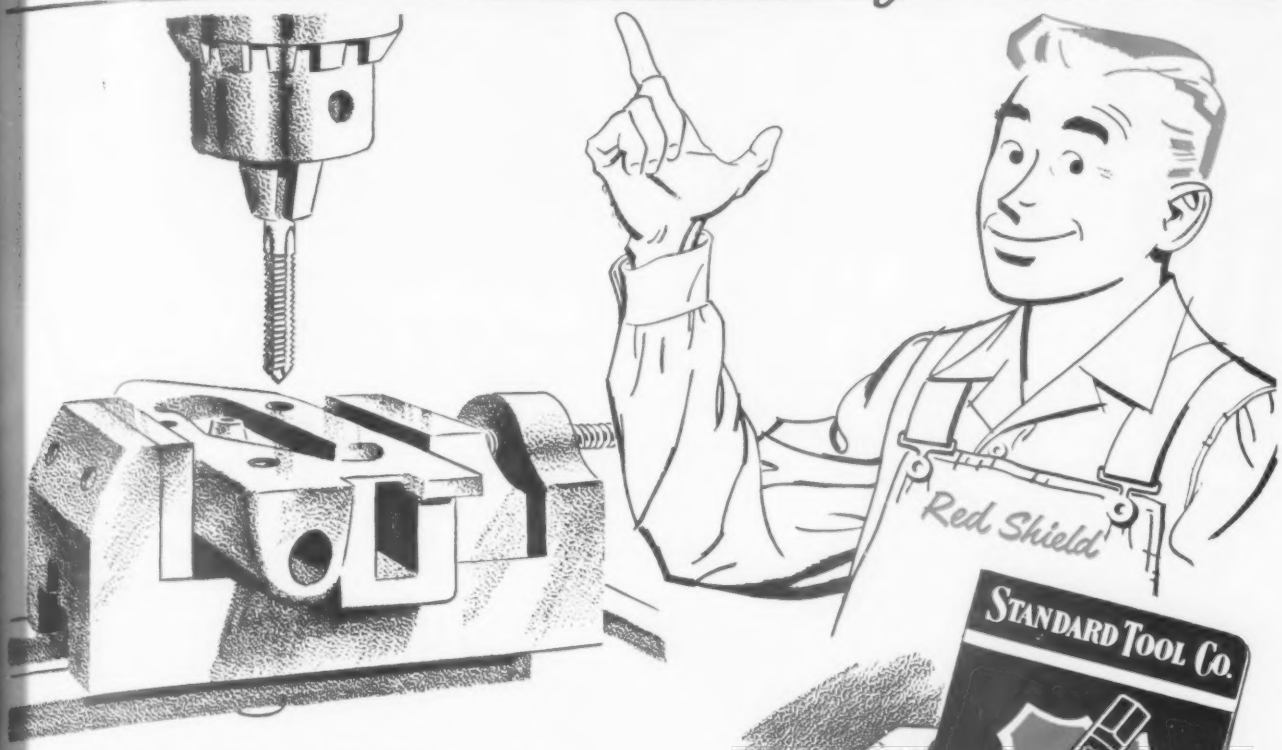
393 PAYNE AVE., NORTH TONAWANDA, N. Y.

(Between Buffalo and Niagara Falls)

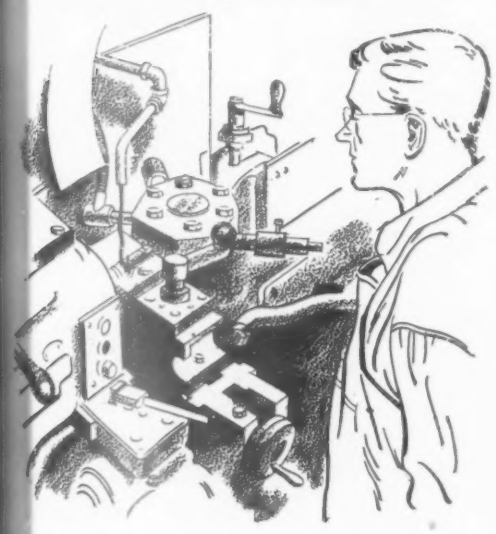
Wales-Strippit of Canada Ltd., Hamilton, Ontario

Specialists in Hole Punching and Notching Equipment

TAPPING POINTERS..... by Red Shield



ALUMINUM. Using 8x32 special gun flute taps. Through holes. We suggested 8x32 commercial-ground, four-fluted machine screw taps with special surface treatment. Cut original tool cost and greatly lengthened life of taps.



SERVICE. The local distributor of Standard Tool Co. products will see that you get the help of our Red Shield Service Staff to help on your metal cutting problems. Write for free booklet, "TAPPING DATA".

ALLOY STEEL. Using regular cut thread taps on turret lathe. Through holes. We recommended high-speed, commercial-ground spiral point plug taps with special surface treatment. Also showed them how to sharpen taps. Result: 500 to 1,000 more pieces per grind.

STANDARD TOOL CO. DEPT. 2-F, 3950 CHESTER AVENUE CLEVELAND 14, OHIO

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THE STANDARD LINE: *Drills • Reamers • Taps • Dies • Milling Cutters • End Mills • Hobs • Counterbores • Special Tools*

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H&G DIE HEADS

WITH INSERT CHASERS

FOR ALL MACHINES USED FOR CUTTING SCREW THREADS

The famous H & G Die Heads come in styles and sizes for all types of machines, including threading machines, chucking machines, drill presses, turret lathes, and automatic screw machines, such as Brown & Sharpe, Cleveland, Cone, Davenport, Economy, Foote-Burt, Greenlee, Gridley, Acme-Gridley, New Britain, New Britain-Gridley, Swiss, etc.

The small, inexpensive high-speed steel insert chasers are held by rugged carriers and cut threads straight and true to the close tolerances required.

The majority of expert production men prefer these die heads because of the ease with which insert chasers are resharpened and set, the low cost of insert chasers and the greater quantity of threads per grind and number of pieces threaded per chaser dollar.

The reduction in inventory will pay for new die heads. **For example:** If you have $1,000 in chaser inventory, changing to H&G will require only $300, setting free $700 for the purchase of new H&G heads. This is due not only to low cost of chasers, but to interchangeability and long life.

Check and Mail for Free Copy ☐ "Selecting Proper Die Head for the Job" ☐ Style MM ☐ Style DMS ☐ Style DM ☐ Style TM

THE EASTERN MACHINE SCREW CORPORATION

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Mfrs. General Purpose Die Heads, Insert Chaser Die Heads, Threading Machines.

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PRECISION BUILT ... to your blueprint

SPECIAL CUTTING TOOLS

High Speed Steel and Cemented Carbide Tipped

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Which job would you like to improve?

Listed below are some jobs discussed in Oakite's new 44-page illustrated booklet on Metal Cleaning. Let us help you do them with better results, greater economy.

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Tell me (without obligation on my part) about Oakite methods and materials for the following jobs:

☐ Tank cleaning
☐ Machine cleaning
☐ Electrocleaning
☐ Pickling
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☐ Paint stripping
☐ Steam-detergent cleaning
☐ Barrel cleaning
☐ Burnishing
☐ Rust prevention
☐ Send me a FREE copy of your booklet "Some good things to know about Metal Cleaning"

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OAKITE SPECIALIZED INDUSTRIAL CLEANING MATERIALS • METHODS • SERVICE

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ASK **BAIRD** ABOUT IT!

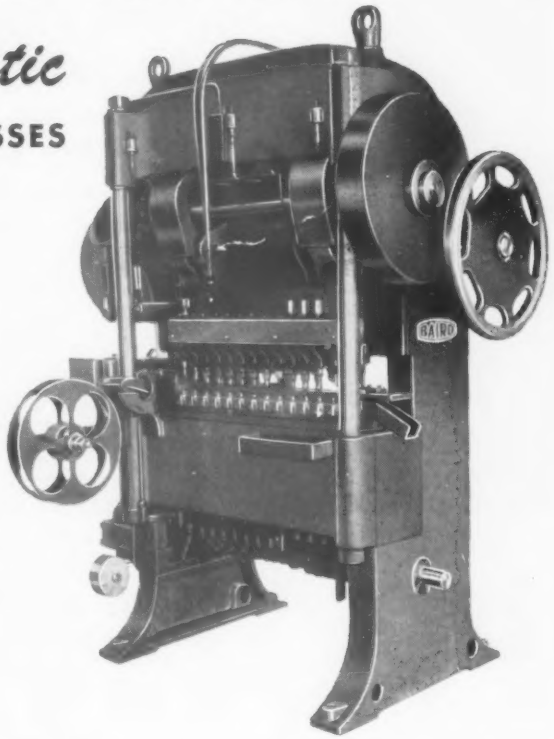
HIGH PRODUCTION TOOLING

FOR REPETITIVE MANUFACTURE OF PARTS FROM COILED STOCK

check

BAIRD *Automatic*

MULTIPLE TRANSFER PRESSES



Simply stated, this press combines, in a single cycle, operations that might otherwise require several smaller machines with an operator for each one.

There are so many varied tooling possibilities that it is impossible to enumerate them here. In ordinary operations the press automatically feeds coil stock for piercing, lettering, embossing, etc., then cuts the blank, places it in transfer fingers, moves it along to several other tool stations and ejects the finished piece. In addition, preformed material may be fed from the opposite end of press for many other operations . . . all completely automatic. A full set of tools (composed of punch and die blocks, their punches and dies, transfer slide and fingers) may be removed as a single unit . . . and a different set inserted, and in some instances without disturbing any adjustment . . . in a comparatively short time. Note the following example:

. . . a typical BAIRD tooling set-up

This is a complete die set with full complement of punches and dies in working position for the production of a special aircraft lock-nut . . . finished in one operation (14 stations). The transfer is in the loading position. After completion of stroke, work is pushed to transfer fingers by plungers operated by cams in back of and under the press. Production: 70 pieces per minute.

Full details of Transfer Press available in new bulletin . . . copy on request. Ask Baird about it!

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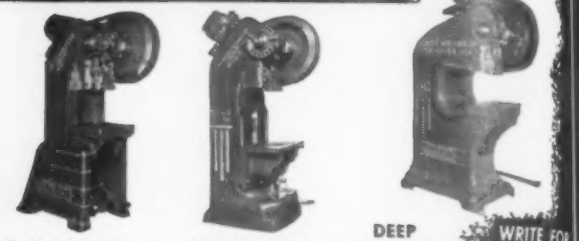
MEANS ROUSSELLE PUNCH PRESSES



O. B. I. PRESS HORN PRESS DEEP THROAT

WRITE FOR DETAILS

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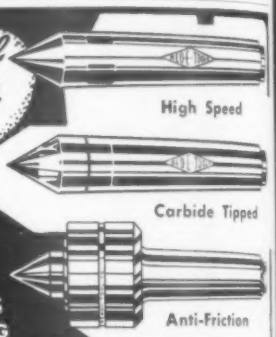
your ONE source for ALL centers

RED-E CENTERS



High Speed

Carbide Tipped

Anti-Friction

for LATHES • GRINDERS SPINNING • MILLING RAILROADS • GEAR PRODUCTION

Export Department 21 West St., New York 6, N. Y.

CENTER *Specialists since* 1908

RED-E-TOOLS

READY TOOL COMPANY

558 Iranistan Ave., Bridgeport 5, Conn.

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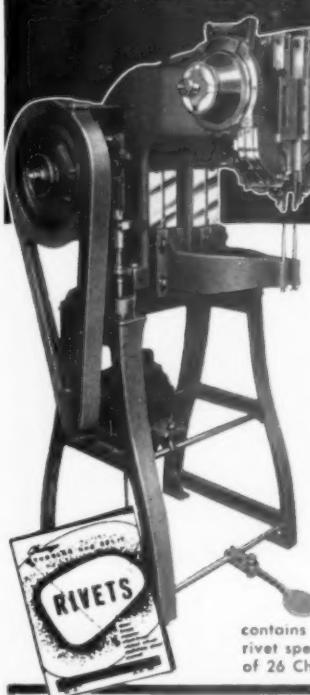
CUT COSTS . . . FASTEN "ON THE DOUBLE"

with the

Chicago

"214" DOUBLE RIVET SETTER



The "214" automatically feeds, inserts and clinches two rivets at a time . . . with speed that may mean a big saving in your fastening costs.

14" throat makes large assemblies easy to handle. For tubular rivets as large as 3/16", or less in length. Quick Change Rotary Type Hoppers and Raceways permit a 5-minute changeover to rivets of different size. Adjustable anvils and riveting centers add to its versatility.

Ask us how the "214" can help you cut costs. Send a sample of your problem assembly (or blueprint) for a Free fastening analysis.

FREE CATALOG

contains valuable engineering information and rivet specifications plus illustrated descriptions of 26 Chicago Automatic Rivet Setters.

Chicago Rivet & MACHINE CO.

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Branch Factory: Tyrone, Pa.

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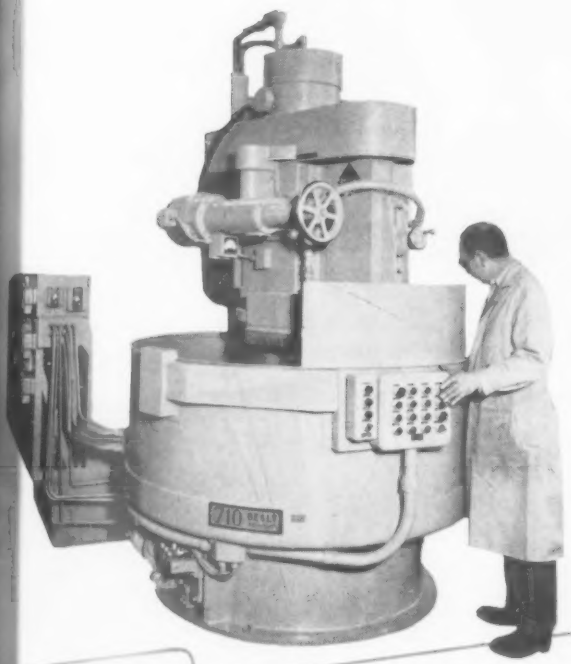
One Grinder — Twice the Output

the new BESLY-BOWEN RADIAL HEAD FACE GRINDER

multi-station fixturing doubles piece output in sequence operations



Achieves Time-Saving, Continuous Operation

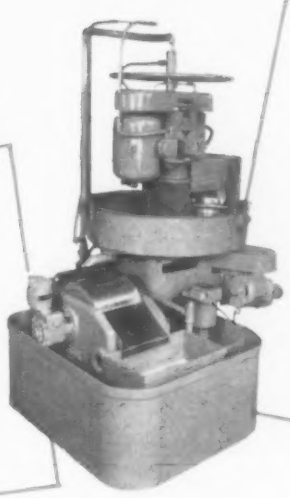
Totally different in basic design, Besly-Bowen Grinders offer distinct advantages for fast, accurate, *low-cost* mass production. No time is lost by machine waiting for operator to unload and reload fixtures . . . or by the operator waiting for completion of operating cycle. Loads at one station while grinding takes place at another.

Balanced assembly head and a single, massive, slow-moving bearing provides four-way compound movement. Micrometer adjustment with *direct reading — free from backlash* — maintains close tolerance *indefinitely.* Other important features: ample coolant flow without splash or spray, hand-operated or fully-automatic operation, ideal loading height (variable) and small floor space.

Write for full details.

CASE ONE

No. 710-18"-30 hp Besly-Bowen Radial Head Face Grinder with automatic cycle control. Used by automotive manufacturer to grind mating surfaces of cast iron chain case covers. 1/16" stock removed from rough casting. Production rate: 90 surfaces per hour. Accuracy: flat within .002" with approximately 30 micro-inch finish. Fixtures: hand-operated, cam-clamping. Grinder is equipped with two 22" diameter variable speed rotary tables and automatic cycle control. Single cycle cam in feed gives rapid approach, controlled speed and a dwell or spark-out period.

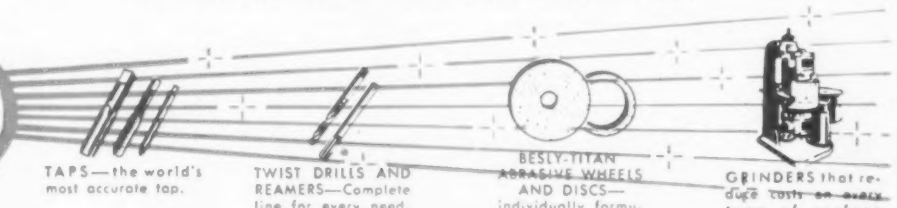


CASE TWO

No. 705-8"-5 hp Besly-Bowen Radial Head Face Grinder for finishing cast iron water pump impellers. Produces 150 parts an hour—removing 1/32" of stock from 6 fins at 15° angle in a single pass of approximately 15 to 20 seconds duration. Head swings clear of the fixture and stops. A limit switch, contacted by grinding head, automatically stops the work spindle rotation.

AVAILABLE IN A FULL RANGE OF SIZES

BESLY



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GRINDERS that reduce costs on every type of surface grinding.

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Builders of Precision POWER PRESSES and FEEDS
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To increase national output so as to meet the additional needs of our armed forces means we'll have to produce more in less time. The cooperation of everyone from the top executive down to the newest apprentice is essential.

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FOR HIGH SPEED CUTTING OF SOFT NON-FERROUS METALS
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SKIP TOOTH IS A HARD EDGE FLEXIBLE BACK BLADE

The teeth of Barnes "SKIP TOOTH" are of special design and proportion in relation to the pitch or teeth per inch. The result is greater gullet capacity permitting fast cutting through heavy sections of non-ferrous metals with excellent chip clearance. Skip Tooth is recommended for plastics, rubber, wood, cork, etc. The hardened, widely spaced teeth cut freely and remain cooler at high speeds.

Ask Your Barnes Distributor for the new Barnes Band Saw folder

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This is it!
This cross-section tells it's own story of how to save money on production drilling

Meyco Carbide Inserted Drill Jig Bushings

MEYCO bushings combine the best features of steel and carbide . . . the protection of steel with the long life of carbide at the points of wear. First cost: higher; end result: substantial savings in production costs. Made to ASA standards . . . MEYCO bushings will SAVE you money. Don't miss *this* bet. Many sizes now available from stock.

User Says:

"We have a jig setup where four holes are held to a limit of plus or minus .0005" on the spacing. MEYCO bushings were put into service . . . and, after completing 150,000 parts, the bushings show no appreciable wear."

Write for bushing catalog No. 13, for further details and a price list.

W. F. MEYERS CO., INC., BEDFORD, INDIANA

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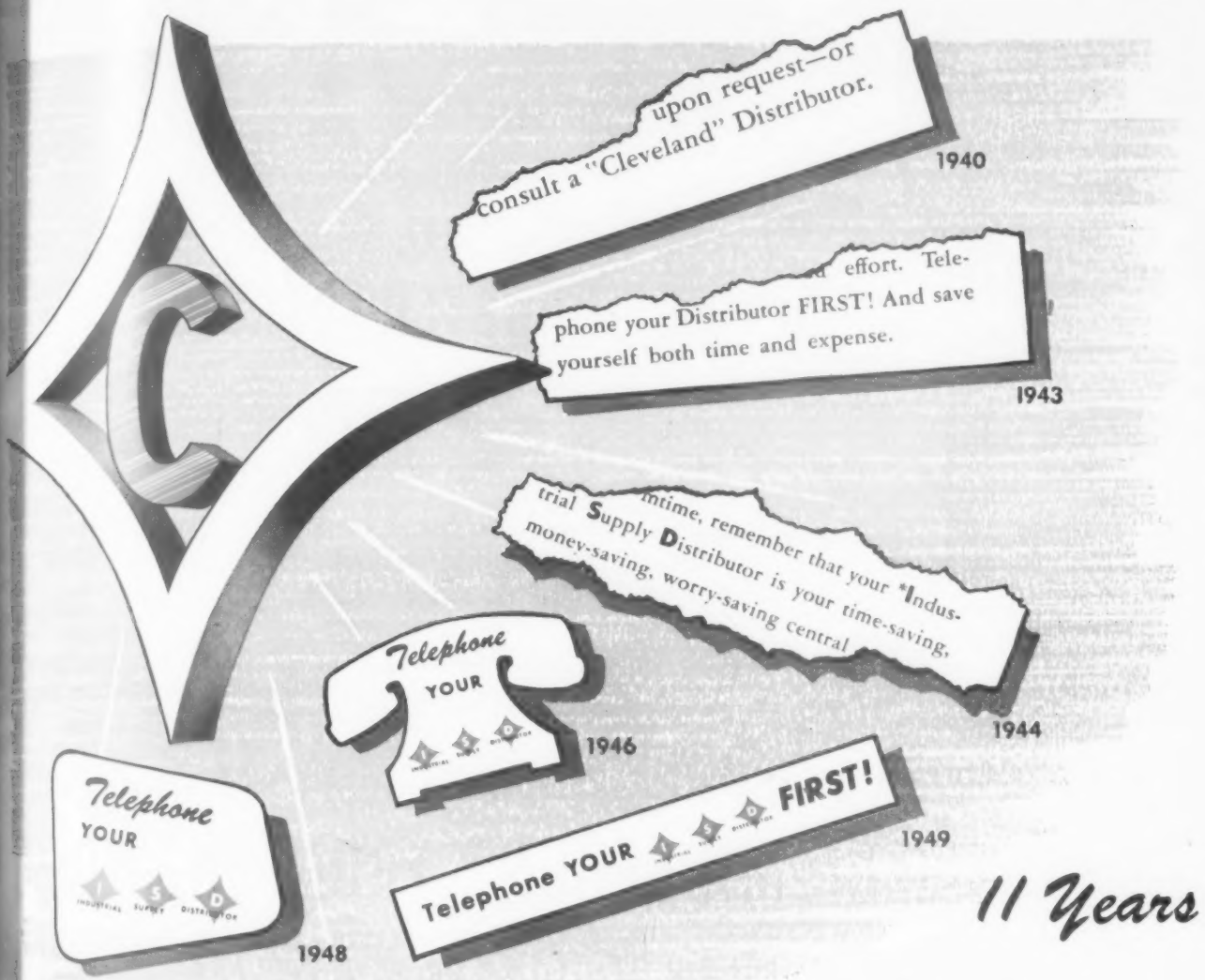

Telephone Your Industrial Supply Distributor

For more than ten years we have been reminding you to "Telephone Your Industrial Supply Distributor" for prompt, dependable service on *Cleveland* Twist Drills, Reamers and other tools bearing the famous ◇ trade mark. The arrangement of the words has been changed from time to time, as illustrated above—but the message always has been the same.

Since 1940 we have been making this suggestion month after month in all of our advertising—and it's just as timely today. Whatever tools, equipment or supplies you may require, you will save time and money by calling your Industrial Supply Distributor *first.* Even in the case of hard-to-get items, you'll find that often he is able to speed deliveries. For your Distributor is a favored customer of many factories; he has "first call" on their production.

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1242 East 49th Street • Cleveland 14, Ohio
Stockrooms: New York 7 • Detroit 2 • Chicago 6 • Dallas 2 • San Francisco 5 • Los Angeles 58
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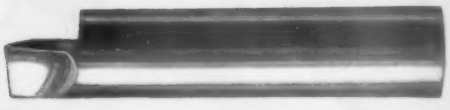
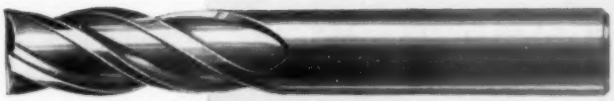
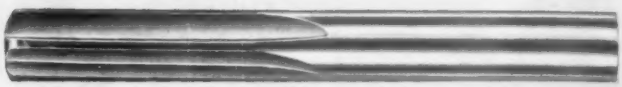
CLEVELAND **DISTRIBUTORS EVERYWHERE Are Ready to Serve You**

They're TUNGSTEN CARBIDE







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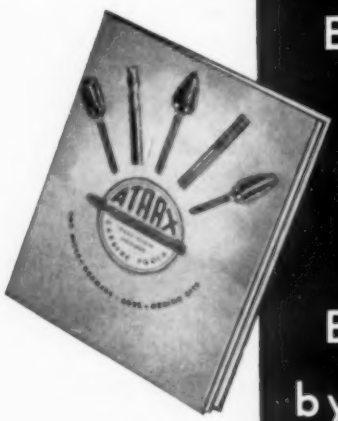

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Extra

PRECISION IN SPINDLE ALIGNMENT

Types to fit any machine used for tapping or reaming.

It is not difficult to get that extra precision which many jobs require in aligning the work with the spindle, if you use a Ziegler Tool Holder. Nor is it necessary to take a great deal of time, as with ordinary tool holders. This is because the Ziegler automatically compensates for inaccuracies in the alignment of the work with the spindle. All that is required is to come within 1/32" of accuracy on the radius, or within 1/16" of accuracy on the diameter and the Ziegler Holder does the rest.

The Ziegler will save you time in making any and all set-ups for tapping and reaming, thus paying for itself in a remarkably short time. Try it on your next job and see for yourself.

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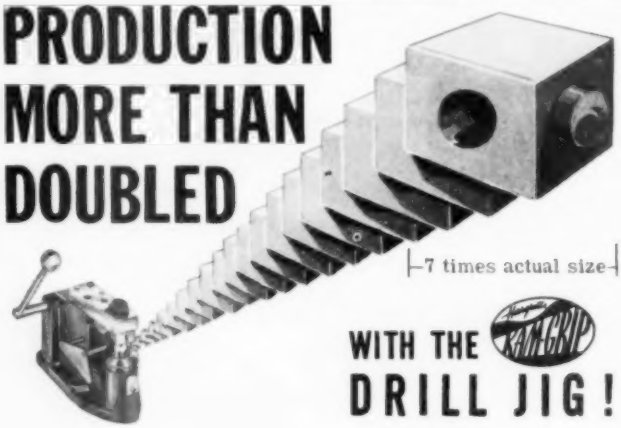
PRODUCTION MORE THAN DOUBLED



7 times actual size

WITH THE KAM-GRIP DRILL JIG!

Kam-Grip Drill Jigs & Milling Fixtures (manually or automatically operated) are increasingly becoming recognized as the "indispensable tool" for secondary operations on small parts up to one inch diameter. Mr. J. R. Park, President of Toledo Automatic Screw Co., Toledo, Ohio, reports his plant was able to increase production of the small B. & S. part shown above (magnified 7 times), from 400 pieces per hour to over 800 pieces on the drilling operation after installation of a Kam-Grip Jig: C. R. Steel—#45 Drill—hole held consistently to B/P tolerance—scrap practically nil.

WRITE FOR CATALOG COVERING COMPLETE LINE OF KAM-GRIP DRILL JIGS AND MILLING FIXTURES

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Order MOTCH & MERRYWEATHER

SLITTING AND SLOTTING SAWS

SOLID AND SEGMENTAL CUT-OFF BLADES

from your Local Dealer

OR FROM OUR PLANT IN CLEVELAND..

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COMPLETE RANGE OF SIZES • PROMPT DELIVERY

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COMMAND OUR UNPARALLELED EXPERIENCE IN CIRCULAR SAWING

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Machine de-burring with **NOBUR** *pays BIG production dividends!*

NOBUR Tools *turn a slow bench operation into fast and efficient machine work!* Remove burrs on multi-walled parts with a smooth, clean cutting action that won't mar highly finished surfaces. Eliminate rejects from slow, costly hand work with files, scrapers and abrasives.

Nobur Tools are used on any lathe, drill press, portable drill or flexible shaft. Operation of the double-edge cutting blade is easy and safe ... no skilled help is required, and the spindle never needs to be stopped for either de-burring or chamfering.

Nobur Tools cut freely on either hard or soft metals, are simple in construction and are made in sizes to cover a full range of hole diameters. *NEW "DS" SERIES extends range of NOBUR applications to holes as small as 1/8" diameter. WRITE FOR FULL DETAILS TODAY!

Parts like these quickly de-burred with

NO/BUR TOOLS

NOBUR MANUFACTURING COMPANY

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Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

gh-Speed Tools t Lower Cost with ungsten-Saving 66HS

Bethlehem 66HS performed so well during the alloy shortages of World War II that many users of high-speed steels never did go back to the large-scale use of 18 pct tungsten grades. HS has a balanced content of tungsten molybdenum; and it has proved ideal a wide variety of cutting tools. Be- of its lower cost and many uses it ch more than just an able substitute the high-tungsten steels.

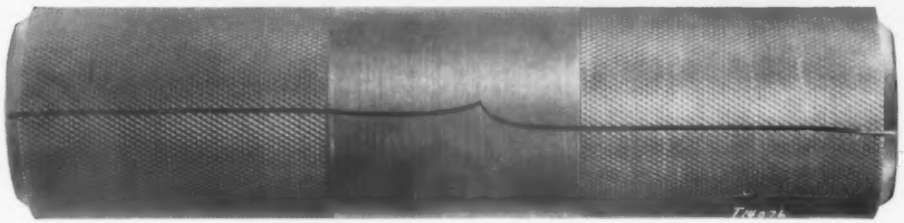
In Bethlehem's own machine shops, for example, 66HS has been used since 1942 for more than 90 pct of all our high-speed tools. We use many tons of it each year; and our production men report that year after year grade performs just as well or better Special HS, our 18-4-1 type of steel. ere's an economy angle to 66HS that dn't be overlooked, especially by users. 66HS at present prices costs about $700 a ton less than standard 18-4-1 grades. And it's 6 pct lighter, too.

66HS is hardened at 100 degrees below the hardening temperature for high-tungsten grades. It requires careful heat-treating, but it presents no problem at all to any heat- who has accurate temperature in- tors. This equipment is necessary se 66HS does *not* form beads of on the surface when the proper ening temperature is reached (2250 to 2275 F).

66HS has just the right degree of wear-resistance, toughness, and red-hardness for use nearly everywhere as a de- able, general purpose cutting steel. typical analysis:

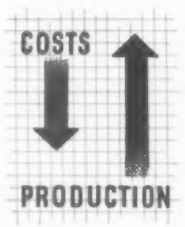
W	Mo	Cr	V
6.35	5.0	4.15	1.90

ke to know ore about it? Ask for Booklet 20 describing 66HS and Bethlehem gh-speed steels.



This 1⅜-in. diameter gage, made from oil-hardening tool steel, cracked because it wasn't tempered immediately after the quench. Tempering relieves stresses set up in the steel during hardening.

Tool Steel Troubles Usually Have Happy Endings



Based on the many thousands of investigations they've made, our metallurgists and research men say that probably less than 3 pct of tool failures can in any way be blamed on the tool steel.

Tool failures are usually cured by one or more of these remedies:

1. Improving the tool design
2. Using a more suitable tool steel
3. Correcting the heat-treatment
4. Improving tool-grinding technique

Some people who think they don't have tool problems quite often aren't getting best results. For example, a plant may suddenly have a series of broken tools or dies. We're called in to help put a finger on the cause. And quite likely we'll find they have been overlooking some vital factor in tool design or heat-treatment. Correcting the trouble leads to tool performance that's far beyond the best previous service life. That's why most tool steel troubles have a happy ending.

If you have a problem involving tool steel or feel you should be getting better tool performance, let us hear from you. Maybe we can give you the right answer pronto. Or a Bethlehem metallurgist may have to work with you in your shop. In either case, there's no obligation.

Our Tool Steel Engineer Says:

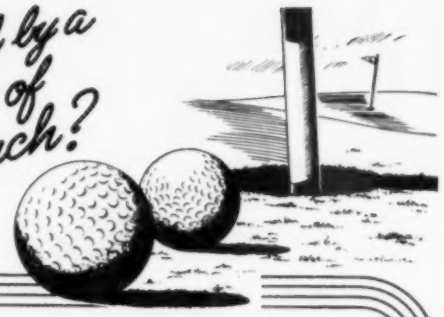
Making shock tools too hard causes premature failure

Most shock-resisting tool steels give best service when hardened between Rockwell C-55 and 60—averaging about C-58. This hardness range provides the best compromise between toughness and wear-resistance. Premature failure is often the result of obtaining an excessively high hardness in these grades. Carbon tool steels are often best for shock tools requiring a hardness above Rockwell C-59.

The chrome-tungsten grades of shock-resisting tool steel can be carburized to obtain greater wear-resistance. This treatment produces a thin, hard case on the tool surfaces, yet retains a tough core of lower hardness. This method is often used for master hobs, reamers, swaging dies, and various kinds of shock tools.

Bethlehem ULTRASONIC TESTED **Tool Steel**

Stymied by a fraction of an inch?



AMES

THERE IS AN AMES INDICATOR OR GAUGE FOR VIRTUALLY EVERY MEASURING PROBLEM

Today increased production is the keynote of the nation's industrial plants. Outmoded inspection methods slow down the effort. Perhaps Ames can assist you. Ames full line of micrometer dial indicators and micrometer dial gauges plus their unequalled design and engineering ability, offers you the solution to practically any measuring problem controlling quality of process or product you may have. Ames experience includes the successful solution of out-of-the-ordinary problems such as the checking of chatter in grinding, the thickness of potato chips, the stretch of bolts as well as the everyday quality control problems of industry. Call on Ames today — the service is yours for the asking. Don't let production be stalled by outmoded inspection methods.

Representatives in principal cities B. C. AMES CO. *50 Ames Street Waltham 54, Mass.*

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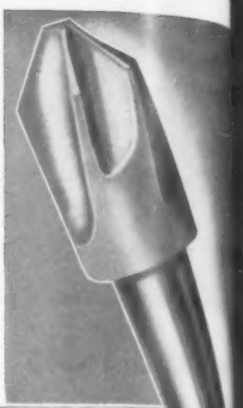
Made in 12 sizes in all degrees; also supplied as sets in strong Kit-cases.



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(TUNGSTEN CARBIDE)
MEETS EVERY REQUIREMENT

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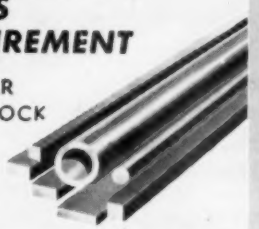
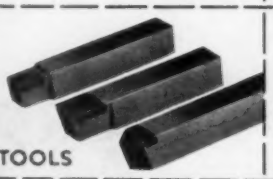
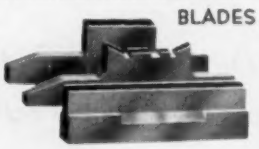



TOOLS

BLADES


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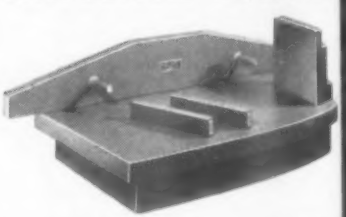

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Warp-free, Rust-free, Bump-free, Extra Hard, Super Smooth

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Let Scully-Jones experienced engineers design your dies, fixtures, gages, jigs, machines, products and cutting tools.

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Write or call Bishop 7-5907 for Bulletin No. 15-50 on Scully-Jones Engineering and Design Service. It shows how S-J engineers work in your plant or ours to save you time and money.

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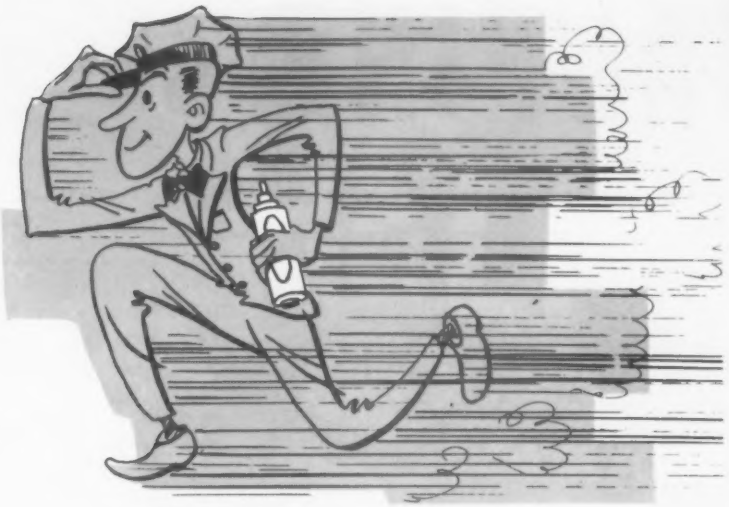
PROMPT DELIVERY plus* . . .



WHEN YOU SPECIFY **O-M** CYLINDERS

* MORE POWER IN LESS SPACE AT LOW COST

—as provided by these talked-about features:

Compact Performance

Simplified design eliminates tie-rods and bulky end caps. Saves up to 1/3 space when installed.

Flexible Performance

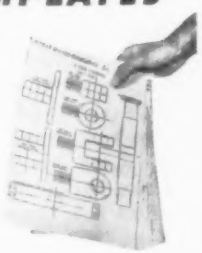
Interchangeable mounting brackets may be fitted without disassembly. Pipe Ports adjustable to any angle. Easily disassembled and re-packed.

Low Cost Performance

Lower first cost . . . smaller inventory . . . minimum maintenance.

FREE TEMPLATES

For the first time in the industry, O-M offers a complete set of templates showing all cylinders and mounting brackets. ½ scale. Your set on request.



O-M manufactures:

- **Air**
- **Water**
- **Hydraulic**

Cylinders

In full range of sizes from 1½ to 8" bores. All machined steel and bearing bronze.

ORTMAN-MILLER
MACHINE COMPANY, INC.

1216 150th Street, Hammond, Indiana

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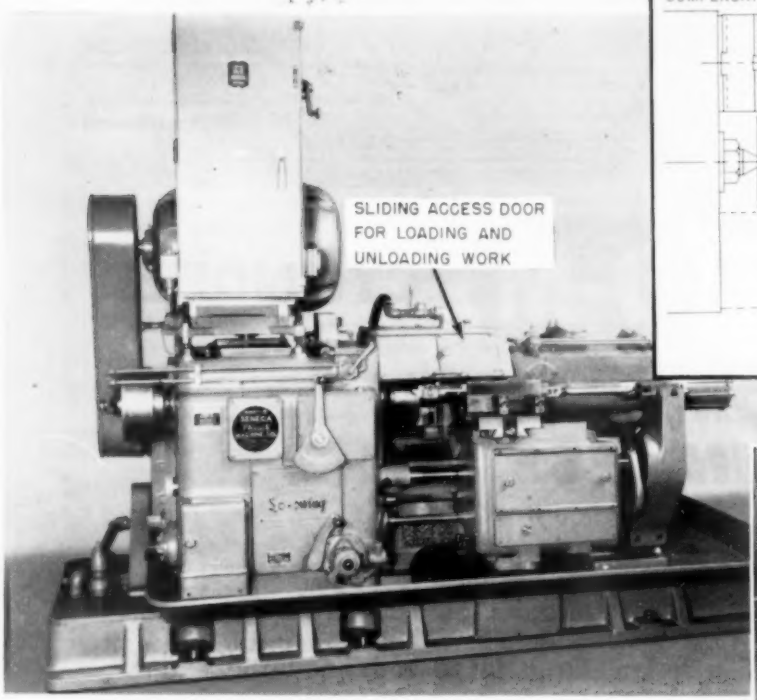
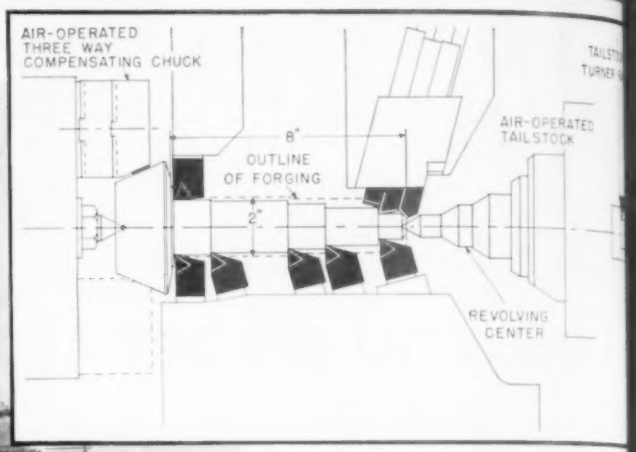
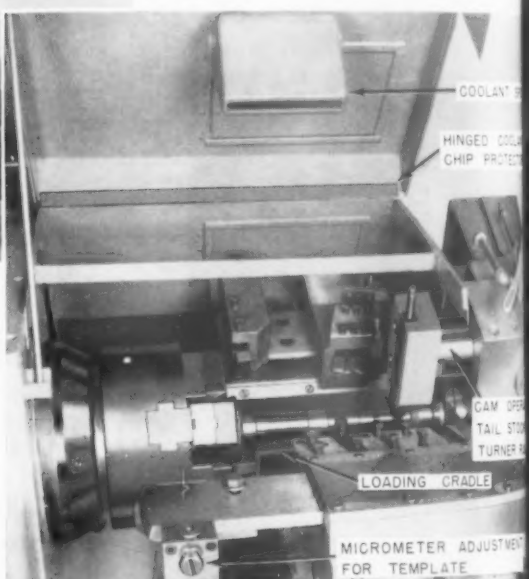
MACHINE OF THE MONT

PREPARED BY THE SENECA FALLS MACHINE CO. "THE *Lo-swing* PEOPLE" SENECA FALLS, NEW







MODEL "AR" AUTOMATIC *Lo-swing* LATHE TURNS REAR AXLE PINION AT FAST PACE

Problem: **Turn and face all stem diameters of Axle Pinion simultaneously, taking two cuts over the threaded diameter to remove large amount of surplus material.**

Solution: **The Model AR Lo-swing Lathe selected for this job was equipped with a cam-operated auxiliary turning ram mounted on the tail-stock casting and fitted with a carbide tool for removing surplus material ahead of a front carriage turning tool which does the sizing. The broken line on the drawing shows the actual shape of the forging and the large amount of surplus material at the threaded end. This drawing also shows the disposition of the tooling for turning and facing all diameters. All tools are tungsten carbide cutting at high surface speeds.**

The machines supplied for this job were equipped with heavy chip guards to protect the operator from flying chips and coolant. Upper illustration shows the front sliding door thru which work is loaded and unloaded. Lower illustration shows the entire hinged hood in an upright position to facilitate tool changes and ments. Note that the coolant spout is attached moves with the hood. This view also shows th operated tailstock turner ram and the loading for the parts.

In operation, the operator simply opens the door, places a rough forging in the loading cra closes the door. The air operated tailstock pushes the part into position on the headstock the chuck jaws clamp the piece and the mac then started. A safety devise prevents starting machine spindle before the chuck jaws are thereby preventing damage to the cutting too other equipment.

Seneca Falls engineering staff is at your disp help solve your turning problems.

SENECA FALLS MACHINE CO., SENECA FALLS, N. Y.

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Independent carbide toolmakers have found through years of experience that ADAMAS enables them to turn out better tools on a faster delivery schedule. The availability of a complete line of standard and special tips in *work-proved* grades has made them eager to use ADAMAS tungsten carbide.

Specify an ADAMAS grade on your next job and have the advantages of ADAMAS *quality, delivery and price.*

YOU CAN HELP YOUR CARBIDE TOOLMAKER BY SPECIFYING

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The revised ADAMAS "Carbide Manufacturers' Grade Recommendations" showing grade recommendations of all carbide manufacturers will help you in selecting the proper tungsten carbide for your job. Write for your FREE copy.

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T-P Chromium Plated Cylindrical Ring Gages are available in sizes from .240" to 12"
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*Norbide (Boron Carbide), Trademark of Norton Co., Reg. U. S. Pat. Off.
T-P Style 9324 AGD Flange-type External Ring Gage of hardened alloy steel
T-P External Ring Gage with insert gaging surface of tungsten carbide

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The exceptionally complete Taft-Peirce Gage line includes Emmerton Ball Bearing Plug Gages, special gages to your specifications, and of course all American Gage Design standards. Available in alloy steel, Norbide,* Tungsten Carbide and Chromium plated. Write to:

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INCREASE CARBIDE TOOL PRODUCTIVITY

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• USE *STANDARD* TIPS—USE HARDER GRADES

SPEEDY TIP ADJUSTMENT—USE MAXIMUM FEEDS & SPEEDS

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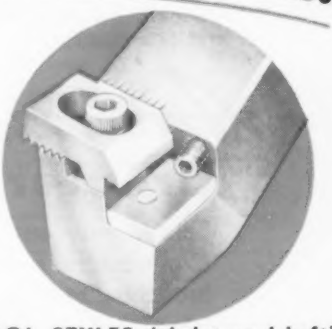

Renewable High Speed Steel Seat—Tip Replacement Quick and Easy.

SIX TOOL STYLES (right and left)

STYLE BRC (right) STYLE FRC (right) STYLE GRC (right)

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Fixed broaches + automatic cycle } = HIGH PRODUCTIO

by broaching the *American* way

PROBLEM To broach six external lugs on a stamped transmission clutch flange part in one pass.
(The previous broaching set-up consisted of three fixed broaches on the machine slide, a receding table and an indexing type fixture. Three lugs were broached in one pass, the table receded, the fixture indexed 180° and the opposite three lugs broached. This did not meet production requirements nor accuracy as the receding table and index fixture allowed too great an accumulation of error.)

SOLUTION A special American 10 ton, 42 inch stroke vertical broaching machine arranged to push the part past six stationary roughing broaches in one pot which nibble and adjustable finishing broaches in the second pot which shave the part. A 3 to 4 times hourly production increase with the part held within the tolerance was the results of this ENGINEERED PRODUCTION broaching operation by American.

OPERATING CYCLE: The operator first loads a part and starts the automatic machine cycle with dual push buttons. The transfer slide moves forward to broaching position and automatically starts the main ram down. Fastened to the ram is a push bar which locates the part and pushes it through the stationary broaches. The part is automatically discharged at the end of the stroke. The automatic transfer slide returns to loading position allowing the operator to reload while the push bar is returning up.

American can give you this Greater Production Economy

This is only one example of how broaching the American-way solved this manufacturer's problems. Because American manufactures a complete line of broaches, broaching machines and fixtures, they can help *you* engineer your job *completely* to obtain the greatest production economy. Start American working for you by sending a part print or sample and your hourly requirements.

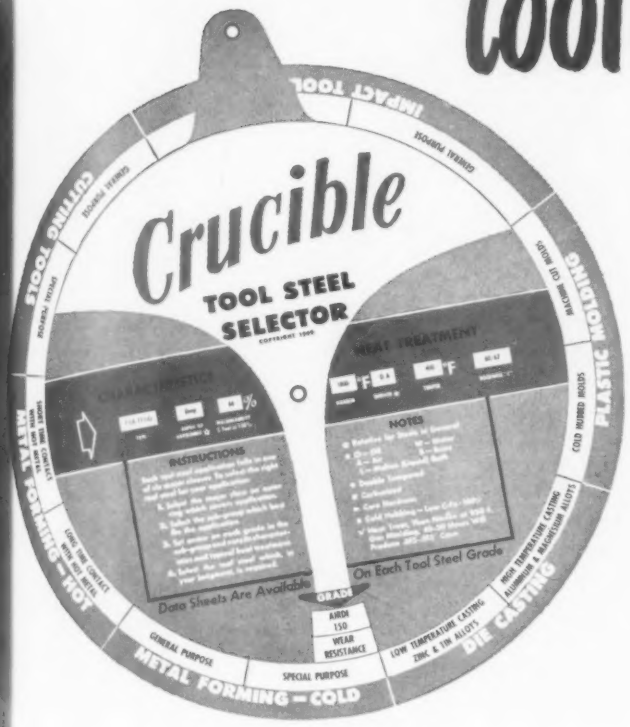
Write for Circular 308 describing American's complete line of hydraulic surface broaching machines.

AMERICAN *American* BROACH & MACHINE CO.
A DIVISION OF SUNDSTRAND MACHINE TOOL CO.
ANN ARBOR, MICHIGAN

See *American* First — for the Best in Broaching Tools, Broaching Machines, Special Machinery

SUNDSTRAND

no more GAMBLING on tool steel selection"



[⅓ actual size; Selector is in 3 colors]

Since the first announcement, hundreds of tool steel users have received their CRUCIBLE TOOL STEEL SELECTORS. The comments received indicate that this handy method of *picking the right tool steel right from the start* is going over big.

"Handiest selector I've ever seen"

"No more gambling on tool steel selection"

"You're right, the application should dictate the choice of the tool steel" . . . and many, many more favorable comments.

You'll want your CRUCIBLE TOOL STEEL SELECTOR. It uses the only logical method of tool steel selection—begin with the application to pick the right steel! And the answer you get with one turn of the Selector dial will prove satisfactory in every case, for the CRUCIBLE TOOL STEEL SELECTOR covers 22 tool steels which fit 98% of all Tool Steel applications. ALL the tool steels on the Selector are in Warehouse Stock . . . that means when you get the answer, you can get the steel . . . fast!

Write for your Selector today! We want you to have it, because we know you've never seen anything that approaches your tool steel problems so simply and logically. Just fill out the coupon and mail. Act now! CRUCIBLE STEEL COMPANY OF AMERICA, Chrysler Building, New York 17, N. Y.

Here's how it works:

To use the Selector, all you need know is the characteristics that come with the job: type and condition of material to be worked, the number of pieces to be produced, the method of working, and the condition of the equipment to be used.

FOUR STEPS—and you've got the right answer!

1. Move arrow to major class covering application
2. Select sub-group which best fits application
3. Note major tool characteristics (under arrow) and other characteristics in cut-outs for each grade in sub-group
4. Select tool steel indicated

That's all there is to it!

Here's an example:

Application—Deep drawing die for steel

Major Class—Metal Forming—Cold

Sub-Group—Special Purpose

Tool Characteristics—Wear Resistance

Tool Steel—Airdi 150

One turn of the dial does it!

And you're sure you're right!!

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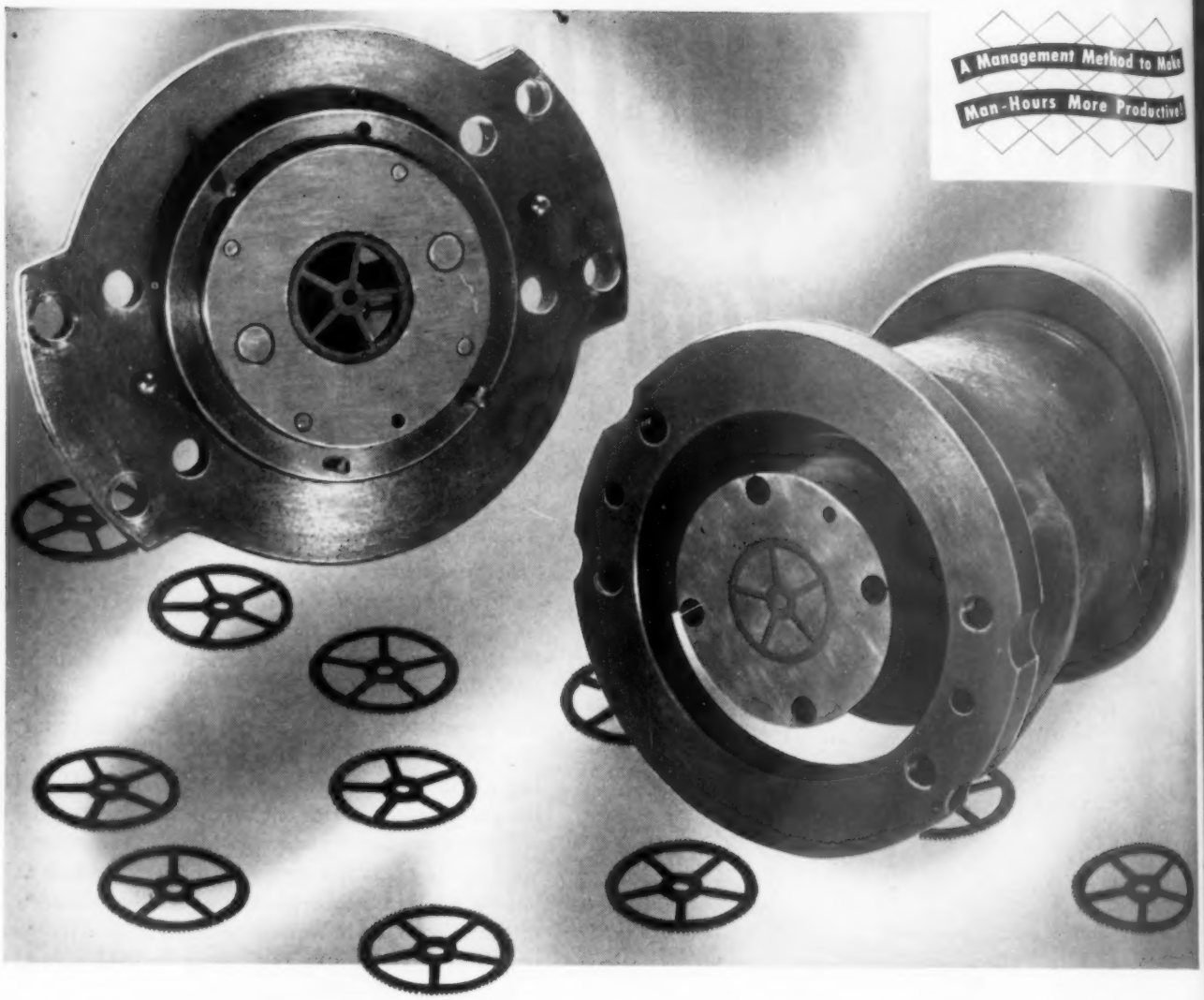

Why Not Gear Up For Today's Production *This* Way?

For 11 years this Stentor blanking die and punch gave trouble-free performance, averaging 100,000 gears per grind. This record enabled management and production to avoid production delays by keeping machines operating with fewer shut-downs for resharpening. The precision gears, 120 teeth/90 pitch, are made from 24 ga., ¾-hard brass. In heat treatment the die moved only .0005" on the maximum diameter of the gear.

It wasn't a happy coincidence that the tool and die steel was perfectly suited to put production from the tools on a smooth, trouble-free basis. It was planned that way—with the help of the Carpenter Matched Set Method. For the Method not only enabled this plant to eliminate costly experimentation in selecting the right steel, but enabled management to forecast output in advance because they could count on the tools to produce the parts *on time*.

Used in hundreds of plants, the Method offers far more than simplified tool steel selection. It makes machine operators more productive. It enables your plant to carry lower tool steel inventories. It makes heat treating easier, simplifies tool-room and production procedures. What's more, it is amazingly easy to apply. No extra cost or bother. To discover what it can do for you, ask for the new booklet "How to Get Better Tool and Die Performance". THE CARPENTER STEEL CO., 154 W. Bern St., Reading, Pa.

Export Department:
The Carpenter Steel Co., Reading, Pa. "CARSTEELCO."

Carpenter

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More than top-grade steels . . . a Method to keep tooling and production on schedule!

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No Broken Castings

No Scratch-Damage to Piston Rods, Bushings and Seals

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NO REPAIRS
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NO POWER WASTAGE

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AUGUST, 1951

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"EVERYTHING IN STANDARD AND SPECIAL CUTTING TOOLS"
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WITH THE NEW Delta Air POWERED Hydraulic DRILL UNIT

Controlled power for automatic drilling, reaming, centering, chamfering, spot facing and hollow milling – and many other operations — FROM ANY POSITION !

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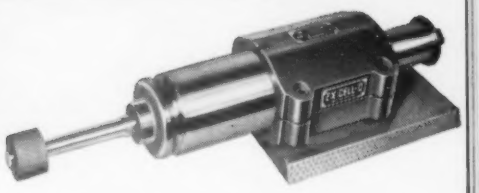
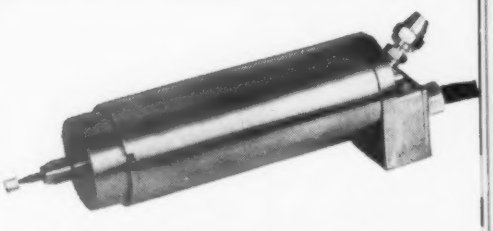
For speed, precision, endurance, your best choice is an Ex-Cell-O Grinding Spindle. You'll find one to suit your needs in the big, 80-page Ex-Cell-O Catalog 25962, supplied with price list on request.

● Leading grinder manufacturers install Ex-Cell-O Precision Spindles as original equipment. You can improve the performance of your grinders with Ex-Cell-O Precision Spindles. They are rigid and smooth-running, permit heavy cuts without chatter, require no lubrication or adjustment. All are fitted with precision ball bearings manufactured by Ex-Cell-O.



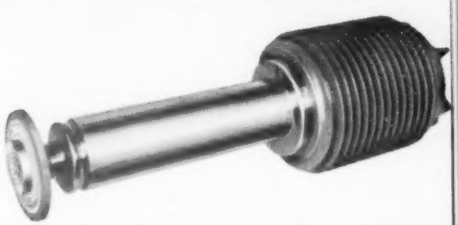
Single-body, belt-driven internal grinding spindle.

Double-body, belt-driven internal grinding spindle.

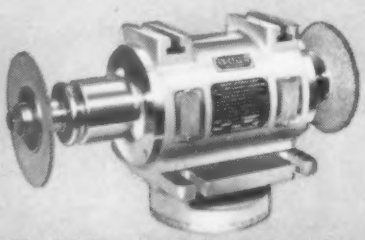


65,000 rpm high frequency inbuilt motor spindle.

25,000 rpm high frequency inbuilt motor spindle.

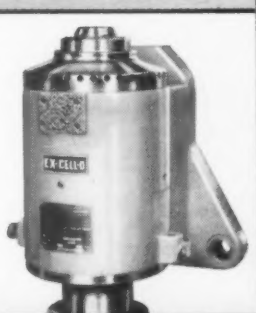


Totally enclosed inbuilt motor surface grinder spindle.



Precision inbuilt motor spindle for cutter grinder.

Vertical precision spindle with inbuilt motor.



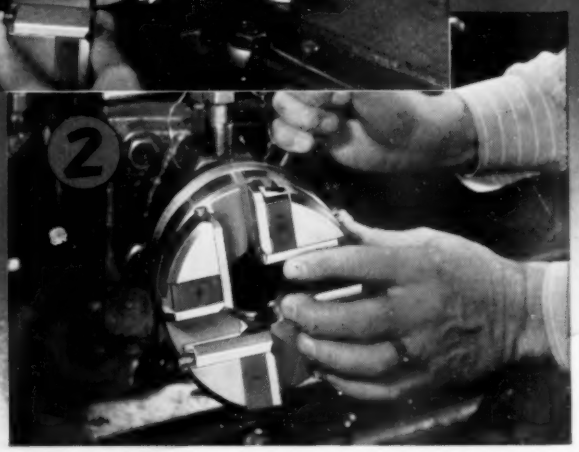
EX-CELL-O
CORPORATION
DETROIT 32, MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS • CUTTING TOOLS
RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • AIRCRAFT
AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

XLO
EX-CELL-O for PRECISION

JUST ONE MINUTE

TO CHANGE MURCHEY CHASERS



1 Simply remove stop collar—t
out chaser and holding block
semblies.

2 Insert blocks with sharpen
chasers against positive locat
—replace stop collar.

WHAT A TIME-SAVER—Downtime for changing chasers on other makes of tangent dieheads is from 15 minutes to one hour. *Only one minute is required to change over Murchey chasers on the job.*

WHAT A SETUP-SAVER—Machine operators change their own Murchey chasers which are already precisely pre-set in the holding blocks.

WHAT A CHASER-SAVER—By means of the Murchey tangent setting fixture, only a touchup grinding wheel cut is required to resharpen—a bare minimum stock is removed. Also, each chaser is positioned to take its full share of the cutting load.

WHAT A MONEY-SAVER—With Murchey chasers, the machine is down for change-over only, 1/15 to 1/60 of conventional change-over time. Setup is done separately by unskilled help when time permits. Murchey chasers wear longer.

5717

Write, wire, or phone for a Murchey "quick change-over" demonstration.

MURCHEY DIVISION
OF THE

Lower Cost per Thread

MURCHEY

SHEFFIELD CORPORATION
DAYTON 1, OHIO, U.S.A.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-146